Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

MAY, 1949

TECHNOLOGY DEPARTMENT

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WEAN

SPECIALISTS IN SHEET, TIN AND STRIP MILL EQUIPMENT

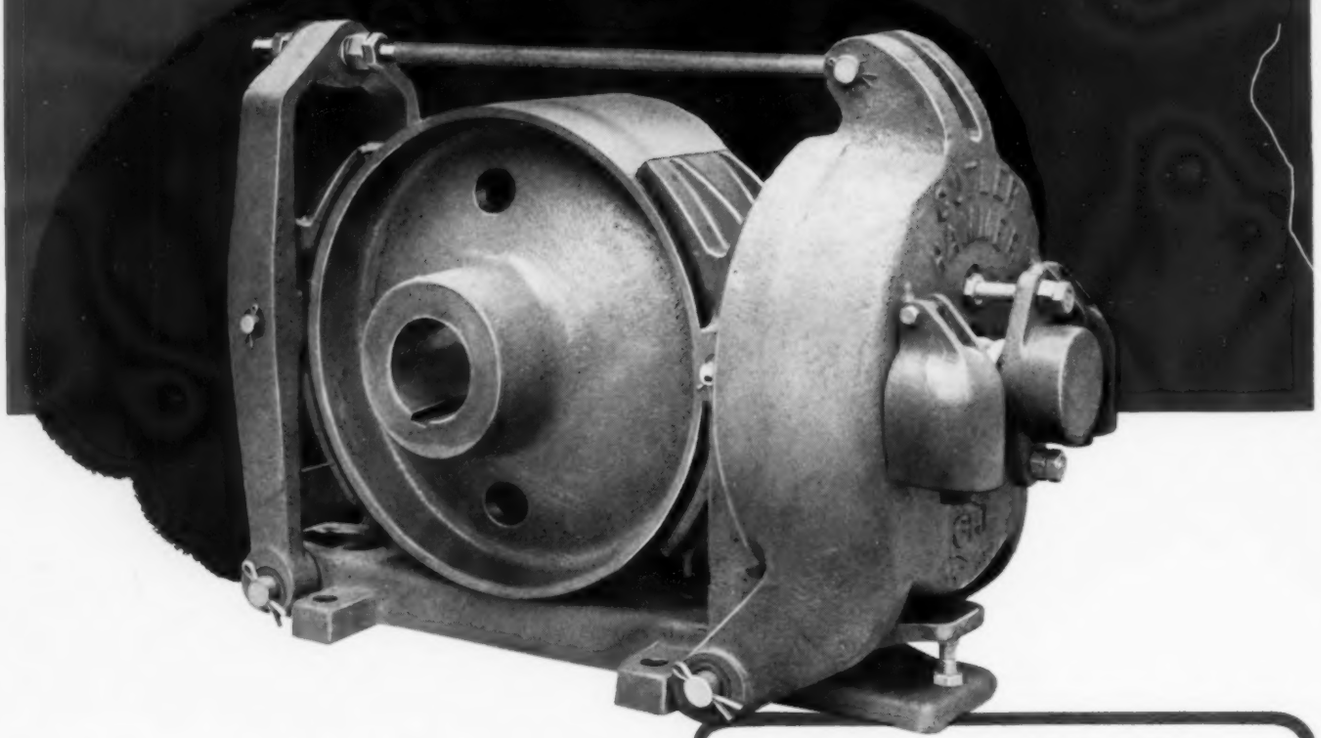
NARROW STRIP WIRE MILL AND STRAIGHTENING MACHINERY

The WEAN ENGINEERING CO., INC.
WARREN, O.

WEAN EQUIPMENT CORP.
CLEVELAND, O.

14 BASIC FACTS

Show this Mill Type D.C. Brake to have No Equal



14 fundamental facts illustrated in the new Cutler-Hammer Publication BR-2 will prove to any man the Type M Brake is the simplest, most durable and dependable brake ever built.

The action is a direct push of the shoes against the brake wheel without any intervening parts. Since the field member and armature member both move in braking and release, the action is lightning fast. The simple design eliminates the parts that usually cause trouble and necessitate adjustment and repair. The tough lining matched with rugged alloy steel wheel cuts down lining wear, and take-up adjustments are needed only at unusually long intervals. The Type M Brake has been proved on a great majority of heavy duty installations to have no equal in performance. You are invited to write for a copy of the informative Publication BR-2. It is free. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wis. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

- The simplest of all brakes
- The brake with the fastest action
- The *only* brake with one-to-one magnet and total shoe stroke
- Tough long-life lining matched with hard Hammerloy steel wheel
- Has the *fewest* parts
- The brake with *only* 3 simple adjustments
- Longest service without take-up adjustments
- Cover-all tubes shield *full length* of hinge pins against paint, dust, etc.
- Renewable hardened hinge pin bushings
- Hard sheet aluminum magnet coil cover plate caulked in place with aluminum wire
- Torque spring compression *CANNOT* be released manually
- Torque spring fully protected
- Brass friction plugs keep shoes always aligned
- Fundamental design proved by years of service in heavy duty applications

All of these features are also provided, when used on A. C. Service with rectifier

CUTLER·HAMMER
MOTOR CONTROL
C·H

It Set the Pattern Years Ago
It has Set the Pace Ever Since

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 26, No. 5

Illustration at right shows examples of hard copper, hard brass, hard brass, red brass (soft), and soft copper.

(Right) Thin wall, large dia. annealed copper tubing pointed to 3".

(Below) 5" aluminum .14" wall pointed to 2½" O. D. ⅛" wall.

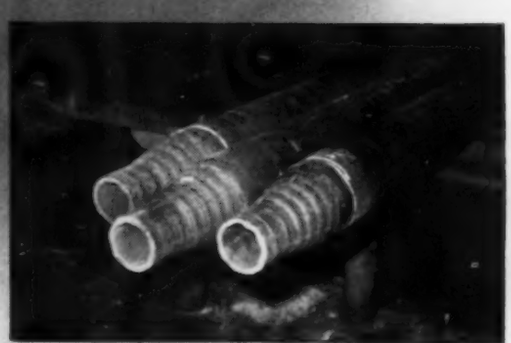
hydraulic squeeze pointer

Closeup showing finished points. Illustrations at lower left, top photo—aerial view showing furnace and pointer. Taking away small dia. tubes and bringing up large dia.; lower photo—closeup of 3 points as they come out of pointer.

(Below) Examples of steel (SAE 1020). Left to right—5" pointed to 4"; 5¼" pointed to 4"; 4" pointed to 2½".

Points tubes FAST...

for cold drawing



SPEED—Much faster than old methods—users report average production of 100 tubes an hour.

EASY OPERATION—One man can handle machine easily.

MANY IN USE—30 pointers in operation now. Many of the major non-ferrous and ferrous producers use hydraulic squeeze pointer for pointing tubes to be cold drawn.

SIZES—300-ton pointer points tubes up to 3⅛" dia. 600-ton pointer points tubes up to 12" O. D. dia. 1200-ton pointer points tubes up to 16" O. D.

INQUIRY—Address The Aetna-Standard Engineering Company for complete information on the cost-cutting hydraulic squeeze pointer.

THE AETNA-STANDARD ENGINEERING COMPANY
YOUNGSTOWN, OHIO

ASSOCIATED COMPANIES:

HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND
AETNA-STANDARD ENGINEERING COMPANY, LTD., TORONTO, ONTARIO, CANADA

Another H-W product... making new records...

THE FOREMOST

provides exceptional resistance to disintegration by CO gas

The excellent service records of H-W 18 Blast Furnace Linings have been made possible by the desirable physical properties of this refractory.

In the manufacture of H-W 18, exceptionally high firing temperature and controlled kiln atmosphere account for the high degree of resistance to disintegration by carbon monoxide gas in service.

Other noteworthy properties are low permeability and porosity, constancy of volume at high temperatures, mechanical strength and high resistance to abrasion.

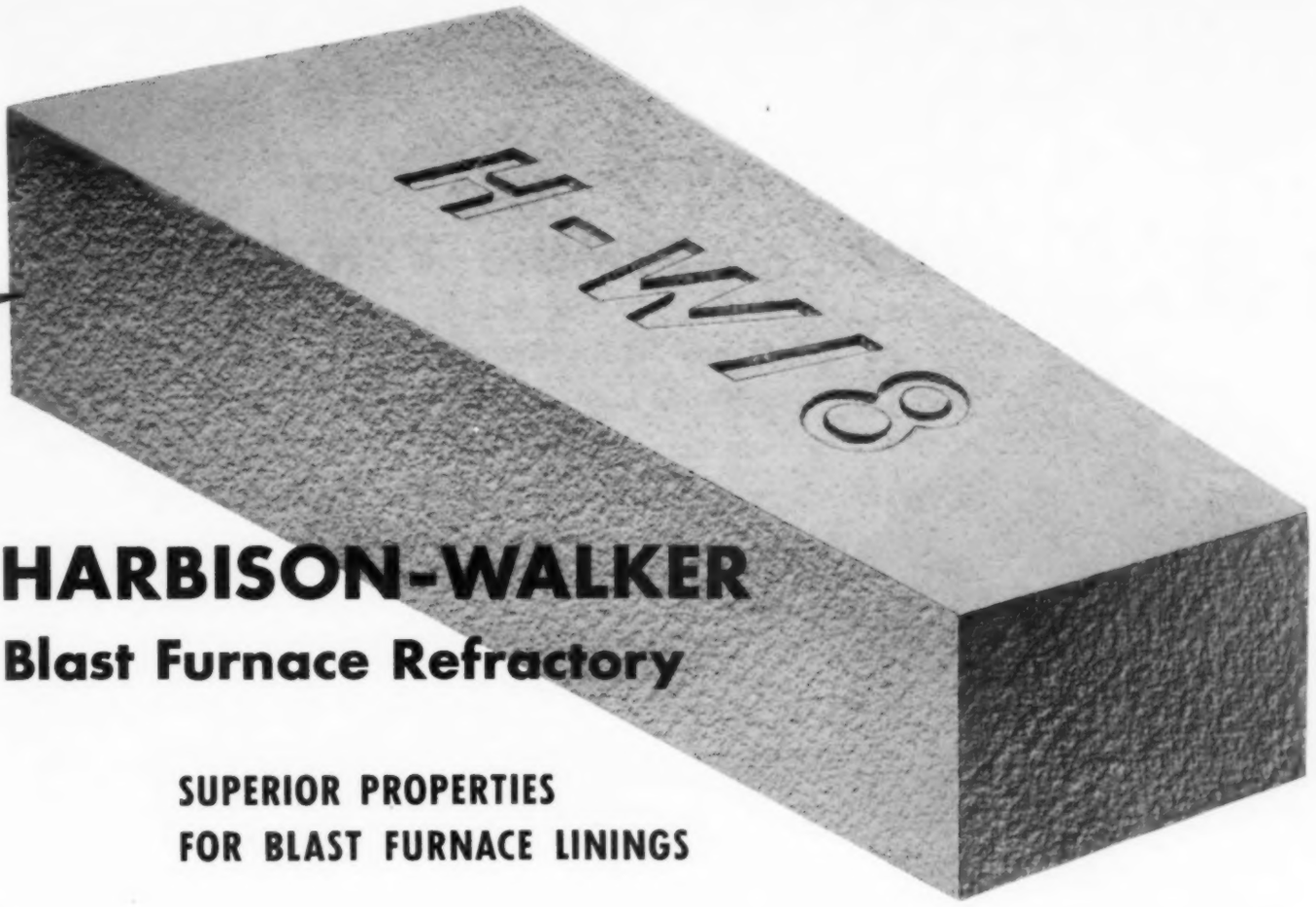
These combined properties make H-W 18 admirably suited for complete blast furnace linings.

The development of H-W 18 marks a definite advance in the manufacture of blast furnace refractories. Their continued large-scale production is assured by extensive mineral resources and the most modern manufacturing facilities.

HARBISON-WALKER

HARBISON-WALKER

world's largest producer of refractories



HARBISON-WALKER
Blast Furnace Refractory

SUPERIOR PROPERTIES
FOR BLAST FURNACE LININGS

RESEARCH—your assurance of QUALITY REFRACTORIES

Constant investigations are conducted by Harbison-Walker Research Laboratories to develop new and better products that will give longer life, better service, permit greater production from the furnaces in which they are used.

To meet the ever-increasing severity of operating conditions with improved refractories, Harbison-Walker employs the most modern techniques and equipment for thorough research and accurate control of quality. An interesting development, shown here, is the use of spectrographic equipment for making rapid chemical analyses of refractories.

REFRACTORIES COMPANY
AND SUBSIDIARIES

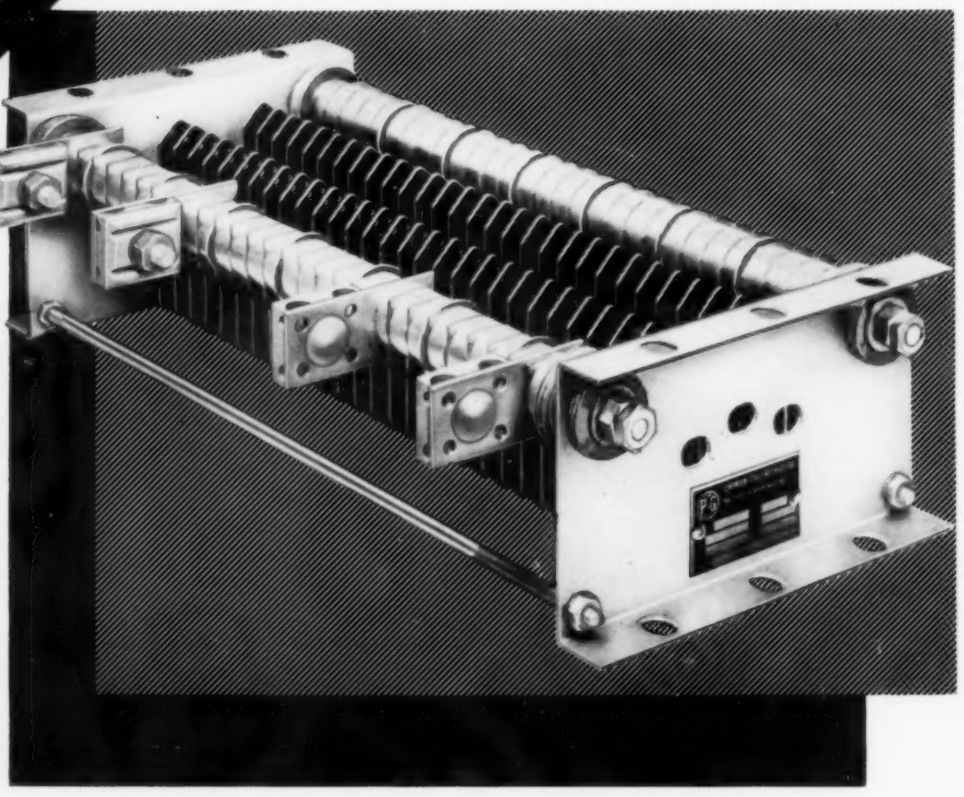
General Offices: PITTSBURGH 22, PENNSYLVANIA

TRADE MARK REG.

P-G *Steel Grid Resistors . . .*

HAVE MAXIMUM VENTILATION

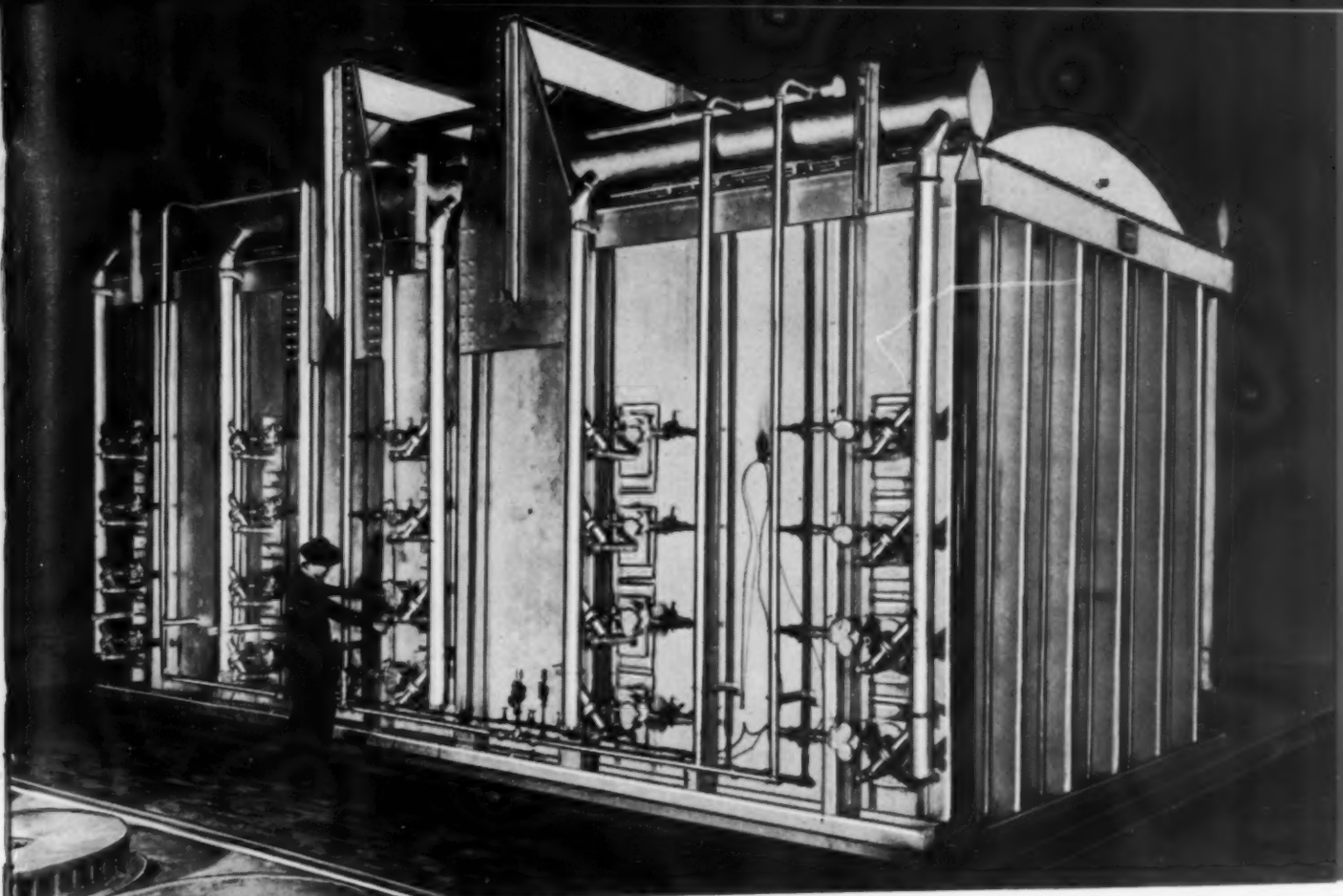
Resistor life depends on adequate ventilation and how efficiently heat may be dissipated . . . P-G grid design equalizes the amount of air space surrounding each leg or loop to obtain even heat throughout the grid area. (Note illustration.) . . . Since heat is rapidly and evenly dissipated, hot spots fail to develop and longer resistor life is assured . . . For a nonbreakable resistor (only steel and mica used) specify P-G on your next application.



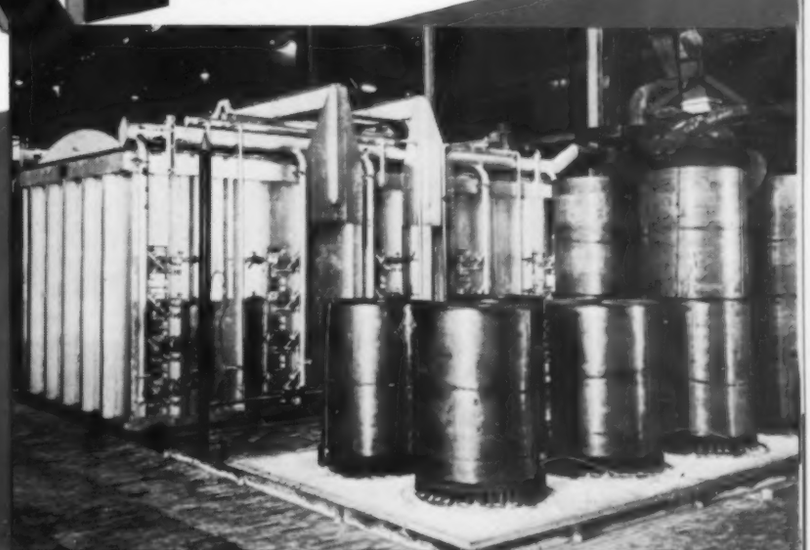
BULLETIN No. 500
Gives detailed information
Copy on request

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY
• ESTABLISHED 1892 •
221 WEST THIRD STREET, CINCINNATI 2, OHIO



SWINDELL • DRESSLER



a recent high-capacity furnace installation for a large strip mill.

MAY WE HAVE YOUR INQUIRIES?

SWINDELL-DRESSLER CORPORATION

PITTSBURGH 30, PENNA.

Designers and Builders of Modern Industrial Furnaces

PRODUCTION UP . . . CONDITIONING COSTS DOWN

Plant records talk like this: *"battery of four Bonnot Billeteers process average of 54,000 tons per machine . . . total of 216,000 tons per year."*

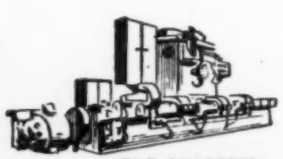
This typical Billeteer schedule was maintained in routine production. Just one man operated each machine per 8-hour shift, without the fatigue and cost that accompanies hand-cleaning methods. Daily tonnage varied according to steel condition, with Billeteers cutting out shallow imperfections or deep flaws with perfect ease. Size of billets handled ranged from 6" x 6" to 12" x 12".

In your plant, too, the "45 tons of machine power" supplied by a Bonnot Billeteer can take on the heavy billet-cleaning load at savings up to 56% as proved by actual production results.

Would you like to see a Billeteer in operation? A note addressed to our Billeteer Division will bring a list of plants where you, too, can see Billeteers biting big chunks out of billet-conditioning costs.

Engineered for Improved Production

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO



THE BILLETEER

ALSO MANUFACTURERS OF SAWING · CRUSHING · PULVERIZING & MIXING EQUIPMENT

CIRCUIT BREAKERS GIVE REPEAT PROTECTION

Nothing to Burn Out
Nothing to Replace

An Enclosure for EVERY APPLICATION

Dust-resisting

Rain-tight

Weatherproof and Dust-tight

Explosion-resisting

Use Square D's Thermal-Coilless Magnetic Circuit Breakers on ALL lighting and power circuits for these additional advantages:

Complete Protection • THERMAL element holds harmless momentary overloads but trips before wire insulation overheats on continuous overloads. MAGNETIC element trips quickly on shorts to localize damage.

Downtime Minimized • Nothing burns out. No live parts exposed. Can be quickly reset by ANYONE.

Non-Tamperable • Factory test-tripped and sealed. Guards against well-intentioned but dangerous home remedies.

Manual Switching • Simple mechanism is designed for long life under severe service. Contacts are capable of interrupting shorts.

More Wiring Space • Compact mechanism permits wide gutter space in SMALL enclosure.

Full Line • Five frame sizes, many ratings and four enclosure types.

	AMPERE RANGE			
VOLTS	ML	ML 1	ML 2	ML 3	WL
250	15-50	70-100	—	125-225	225-600
600	—	15-50	70-100	125-225	225-600

Write for BULLETIN 600. Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan

SQUARE D COMPANY

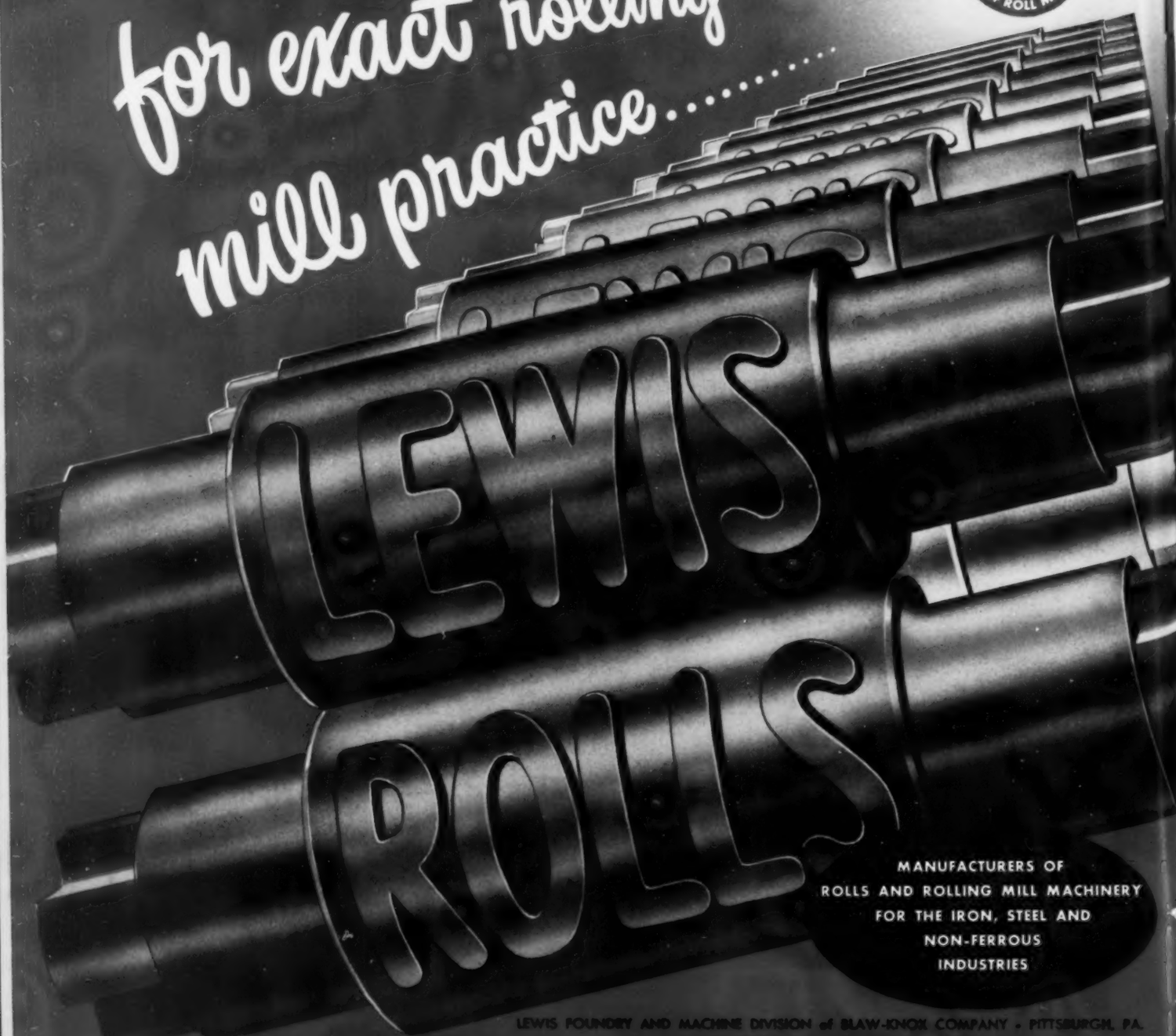
DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S. A., MEXICO CITY, D. F.

PLAIN CHILLED IRON ROLLS
MOLYBDENUM CHILLED IRON ROLLS
ATLAS AND ATLAS "B" ROLLS
SPECIAL PROCESS ROLLS
CLIMAX AND AJAX ROLLS
SPECIAL TUBE MILL ROLLS
AJAX DUPLEX ROLLS
SUPERIOR "X" ROLLS
"X" AND "XA" ROLLS

Quality Rolls for exact rolling mill practice.....

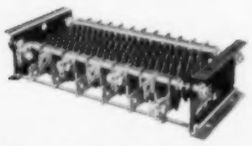
OVER 90 YEARS LEWIS OF ROLL MAKING



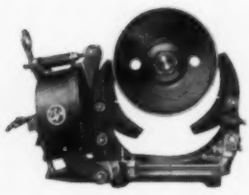
MANUFACTURERS OF
ROLLS AND ROLLING MILL MACHINERY
FOR THE IRON, STEEL AND
NON-FERROUS
INDUSTRIES

LEWIS FOUNDRY AND MACHINE DIVISION of BLAW-KNOX COMPANY • PITTSBURGH, PA.

Complete Control for Cranes



TAB-WELD Resistors—no burning where burning would cause high maintenance.

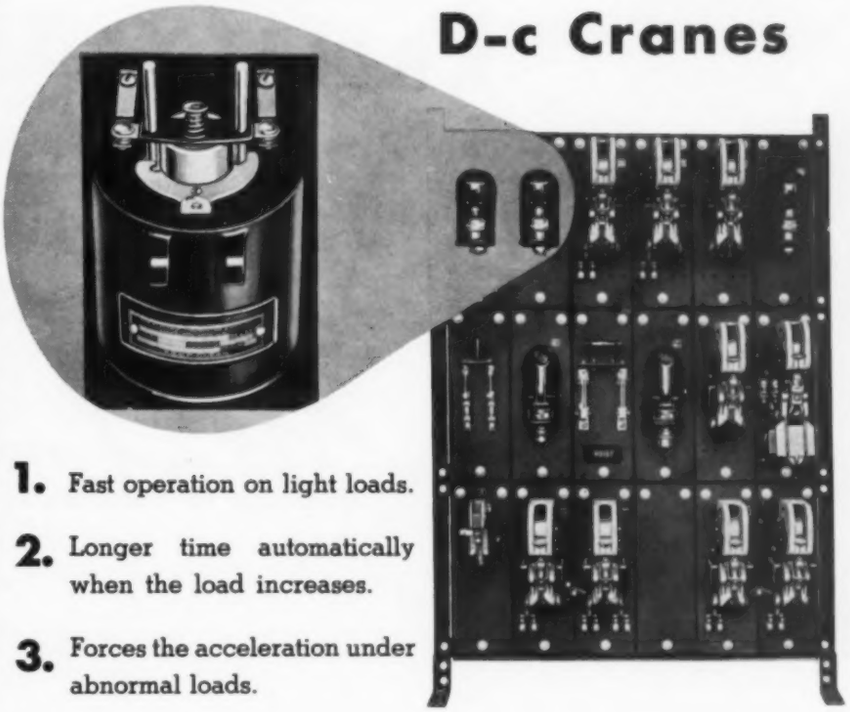


LONG-LIFE Brakes give high speed performance with low up-keep.

SHORT-THROW narrow width Cam Master Switches are easy on the operator.

The World's fastest 600 Ampere Contactor.

Why EC&M TIME-CURRENT RELAYS are *"TOPS"* for accelerating D-c Cranes



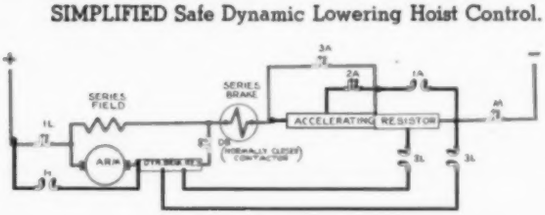
1. Fast operation on light loads.
2. Longer time automatically when the load increases.
3. Forces the acceleration under abnormal loads.

And the relay adjustment *never* fails

Hundreds of EC&M TIME-CURRENT Acceleration Relays are in service with the original adjustment *"untouched."* These ACCELERATORS are unattached, independently working relays—their timing is not affected by wear of other controller parts, loss of liquid, or breakage of springs. Their one moving part is centered magnetically—there is no friction to cause wear in its short vertical travel. Maintenance men appreciate the absence of *"tune-up" time* on EC&M TIME-CURRENT Acceleration Relays.

TIME-CURRENT Relays and LINE-ARC Contactors —a famous combination for efficient cranes.

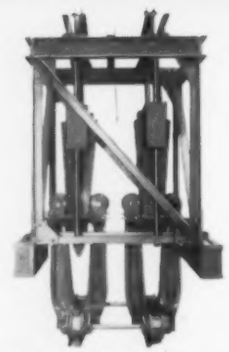
SIMPLIFIED Safe Dynamic Lowering Hoist Control.



CRANE DISCONNECT Switch, Manual-Magnetic for ease of operation.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 East 79th Street Cleveland 4, Ohio

HERE'S AN ILLUSTRATION OF OUR ABILITY TO DESIGN, *Modern* COAL BRIDGES To MAINTAIN and To *Modern* COKE OVENS



The RAIL CLAMPS

Gravity operated, fully automatic, never failing rail clamps of proven reliability protect your investment . . . If bridge is moving they go into action at the command of the Anemometer or the operator . . . They act when the power fails or when the operator cannot function. They "fail" *safe*.

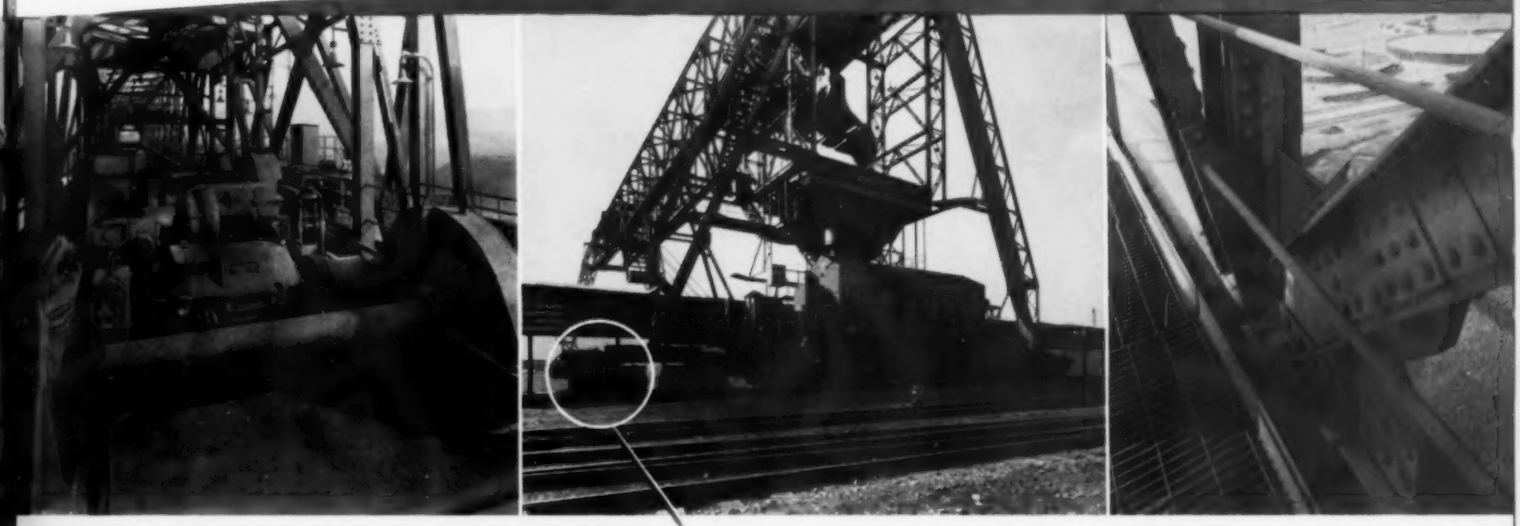
Designing, fabricating and erecting a modern coal bridge is never a routine assignment with Heyl & Patterson. New and practical features are included in every new H & P Bridge. Each new bridge is an improvement over its predecessor, enabling Heyl and Patterson to set the pace in what is new and practical in Modern Coal Bridges.

In the Modern Coal Bridge designed, fabricated and erected by Heyl and Patterson at Follansbee, W. Va. for the Wheeling Steel Corporation you will find many new improvements.

These improvements are possible only when ALL FUNCTIONS OF DESIGN (*electrical, mechanical, constructional*) ALL FUNCTIONS OF MANUFACTURING (*steel fabrication, machine work, assembly*) and finally FIELD ERECTION . . . are performed by the regular employes of one company. Heyl and Patterson, as the leader should, meets all of these conditions.

of *Heyl + Patterson's*

FABRICATE and ERECT BRIDGES INCREASE PRODUCTION in PLANTS



The NEW TROLLEY DRIVE

Using a rigid oil tight floating gear case insures proper alignment of gears under all conditions of load.

Trolley has welded steel frame—anti-friction bearings—dust seals throughout.

These features result in quiet, low-cost operation.

The POWER CONVERSION UNIT

Power for the operation of the bridge is supplied at 250 Volt D.C. by a synchronous M. G. Set mounted on the shear leg sill.

Power for the operation of the M. G. Set is supplied at 2300 Volt, 3 phase 60 Cycle through collectors on the bridge from rails mounted in the structure as shown in the above picture. This assures a constant potential of D.C. Power for the operation of the bridge regardless of its position on the 2400 foot runway.

TRUCKS

The Bridge is carried on 131 pound rails with standard railway gauge on slag ballasted fill.

TYPICAL PANEL POINT ON SPAN TRUSSES

Wide flange structural members, with the web in the vertical plane, have been used to eliminate pockets and to reduce greatly the number of rivets in the bridge members.

This results in lower maintenance and lower painting expense.

The bridge has been "weatherproofed."

HEAVY BULK MATERIALS HANDLING EQUIPMENT

. . . All the Way from Design to Erection

Ore Bridges
Railroad Car Dumpers
High Lift-Turnover-Rotary
Coal Preparation Plants
Coal & Coke Handling Equipment
Boat Loaders and Unloaders
Rotary Mine Car Dumpers
Coal Crushers
Coal Storage Bridges
Car Hauls & Boat Movers
Bradford Breakers
Refuse Disposal Cars
Thorsten Coal Samplers
Kinney Car Unloaders
Pig Iron Casting Machines

Heyl + Patterson, Inc.

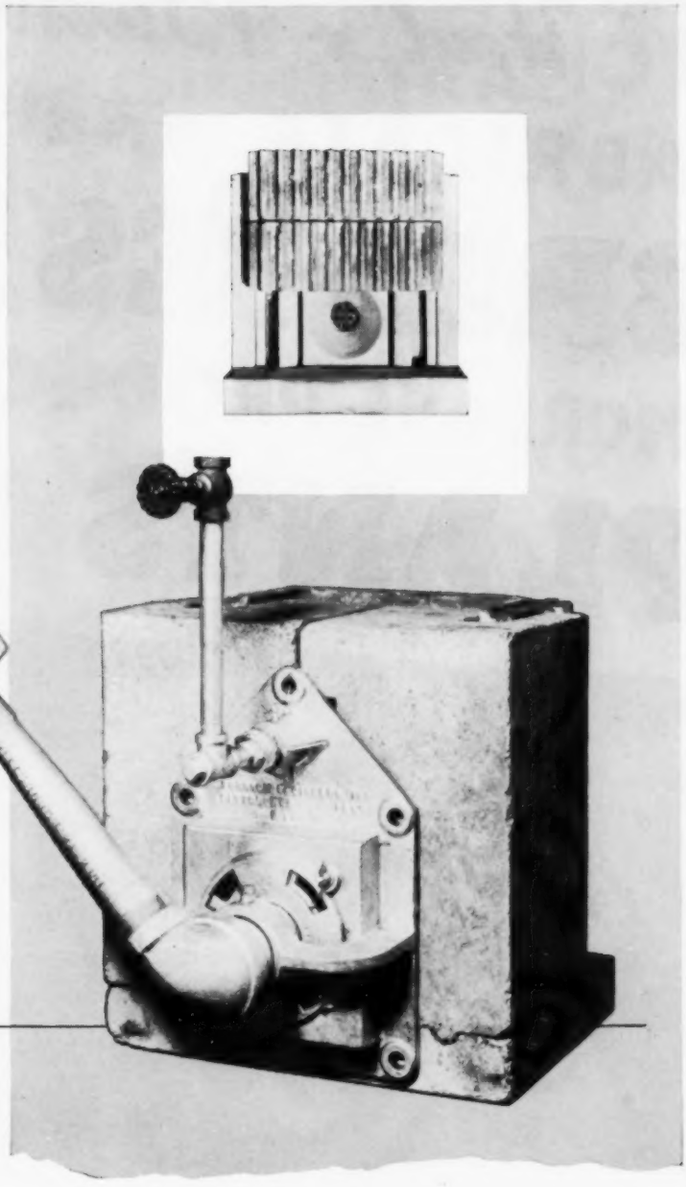
"SINCE 1887"

55 WATER STREET · PITTSBURGH 22, PA.

TO CUT YOUR HEAT TREATING COSTS . . . .

F.E.I. offers

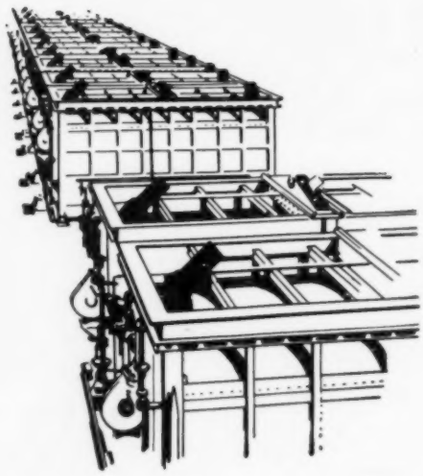
extreme burner flexibility



Whether your heat treating requires a neutral, oxidizing or reducing atmosphere, F. E. I. burners will reduce your costs and maintain quality. These burners possess extremely high up-turns and very low turn-downs, enabling each burner to follow exactly the demand of the controls.

F. E. I. burners furnish both high maximum input and the ability to maintain combustion at the lowest possible capacity when needed. Thus you completely eliminate the need of shutting off burners during idling periods. F. E. I. burners will meet the requirements of every stage of your heating cycle. They will operate with equal efficiency at high or low pressure. They will burn any gaseous fuel—be it butane gas, propane, natural, oil refinery, coke oven gas, blue gas, clean producer gas and clean blast furnace gas.

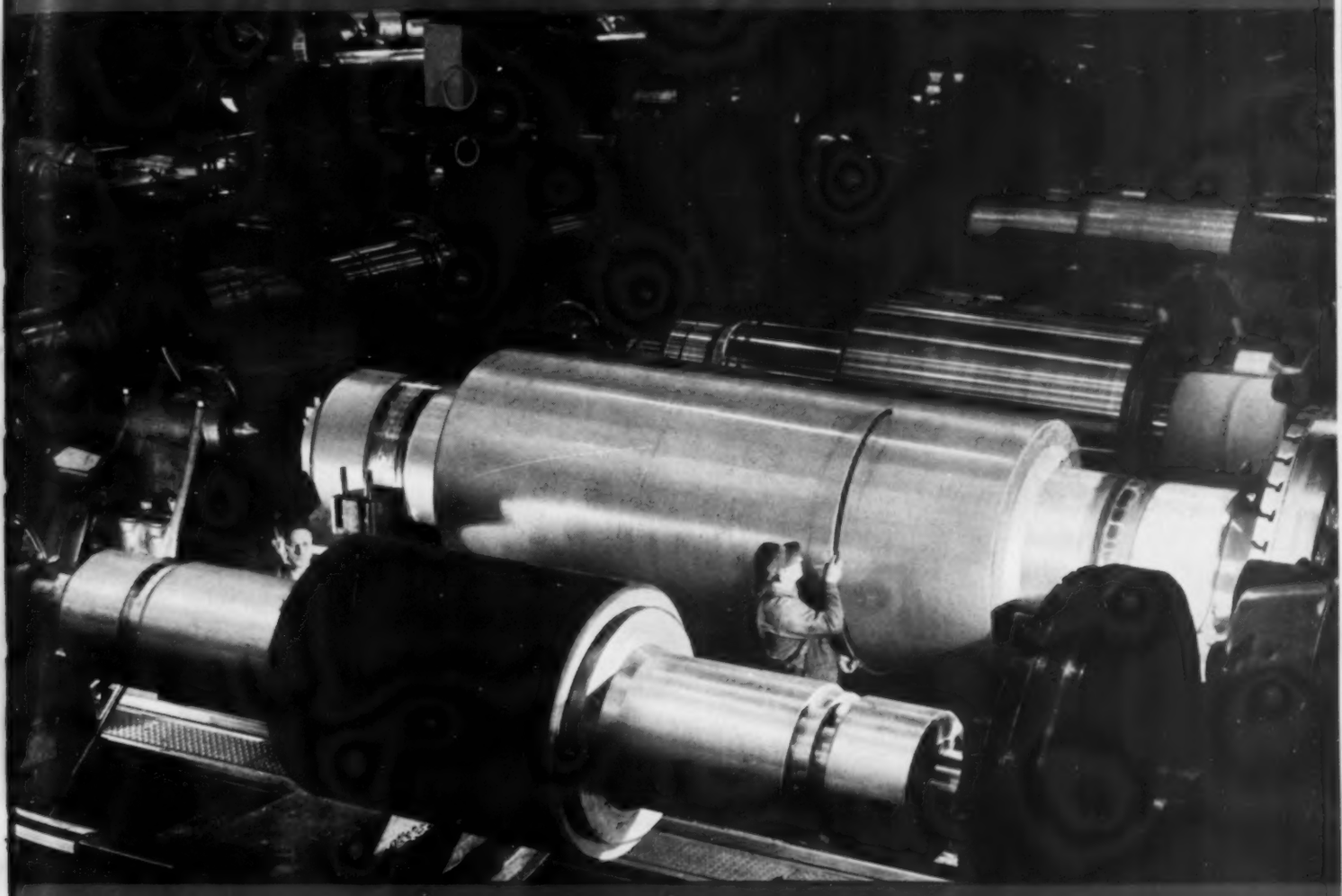
F. E. I. will be glad to furnish detailed information on the cost-saving efficiency of these burners upon request. There is no obligation.



FURNACE ENGINEERS, INC.

1552 WEST LIBERTY AVE. • PITTSBURGH 26, PA.

MESTA ROLLS



A section in one of the Mesta Roll Shops

Mesta produces all sizes of iron and steel rolls including the largest used in industry today. Efficient plant equipment, skilled workmen with long service records, an engineering staff whose technical ability has been accumulated over many years—these resources are responsible for Mesta's leadership in the production of the finest in rolls and other rolling mill equipment.

DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS

MESTA MACHINE COMPANY · PITTSBURGH, PA.

WHEN WATER IS HOT...BAD...or EXPENSIVE

FLUOR FIN·FAN HEAT EXCHANGERS

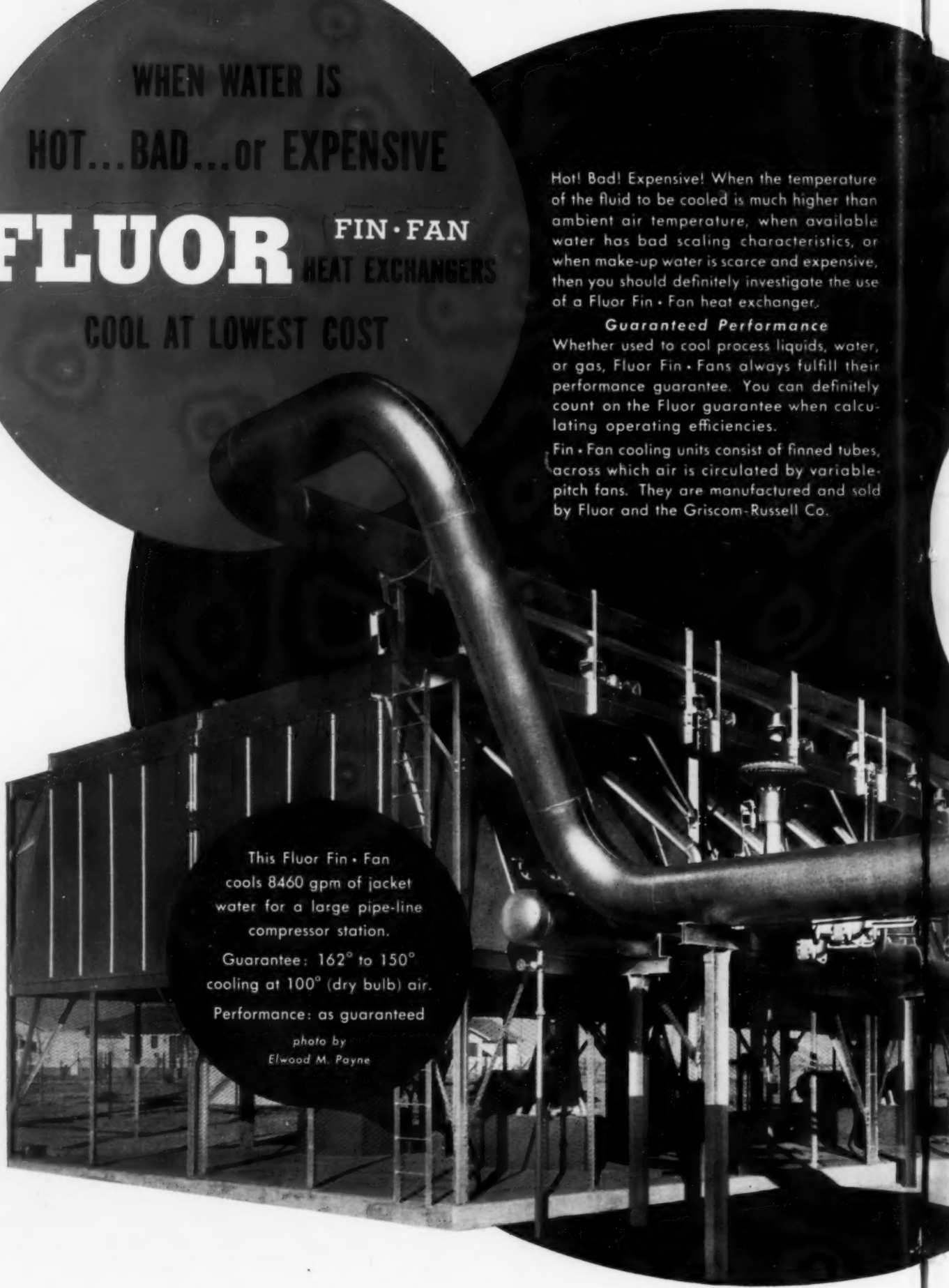
COOL AT LOWEST COST

Hot! Bad! Expensive! When the temperature of the fluid to be cooled is much higher than ambient air temperature, when available water has bad scaling characteristics, or when make-up water is scarce and expensive, then you should definitely investigate the use of a Fluor Fin • Fan heat exchanger.

Guaranteed Performance

Whether used to cool process liquids, water, or gas, Fluor Fin • Fans always fulfill their performance guarantee. You can definitely count on the Fluor guarantee when calculating operating efficiencies.

Fin • Fan cooling units consist of finned tubes, across which air is circulated by variable-pitch fans. They are manufactured and sold by Fluor and the Griscom-Russell Co.



This Fluor Fin • Fan cools 8460 gpm of jacket water for a large pipe-line compressor station.

Guarantee: 162° to 150° cooling at 100° (dry bulb) air.

Performance: as guaranteed

photo by Elwood M. Payne

BE SURE WITH FLUOR

FLUOR

THE FLUOR CORPORATION, LTD.

Los Angeles 22 . NEW YORK . PITTSBURGH
HOUSTON . KANSAS CITY . BOSTON . TULSA
SAN FRANCISCO

Aerator Towers

Counterflo Towers

Pulsation Dampeners

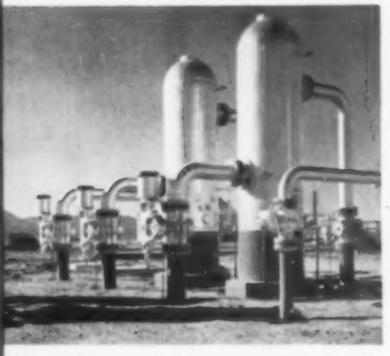
Gas Cleaners

Mufflers

Fluor Aerator cooling towers have distinctive economy features and are most practical in certain cooling applications.

Fluor Counterflo induced-draft cooling towers are a standard of industry for most water-cooling applications. They deliver "colder water cheaper."

Fluor pulsation dampeners remove destructive vibrations and instrument irregularities caused by pulsative gas flow.



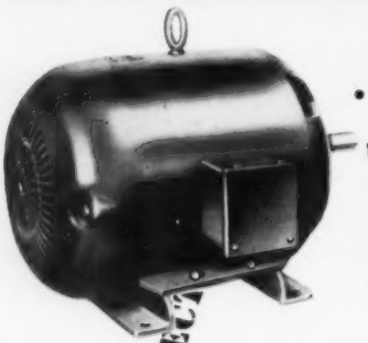
The Fluor gas cleaner, already well-known for efficient cleaning, has been redesigned to give still better performance.

Fluor mufflers, redesigned to incorporate pulsation-dampener principles, reduce exhaust-line noises to less than the mechanical noises of the compressor room.

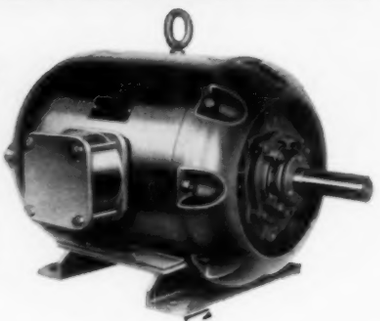
wherever motor hazards lurk... Specify WAGNER PROTECTED MOTORS

Do you use motors in locations where dirt, filings, moisture, splashing liquids, acid fumes, explosive gases, or other motor hazards lurk? No matter how severe the operating condition, Wagner has the right motor for your purpose—adequately protected against such hazards. Five types of Wagner protected motors are shown below.

PROTECTED • PROTECTED

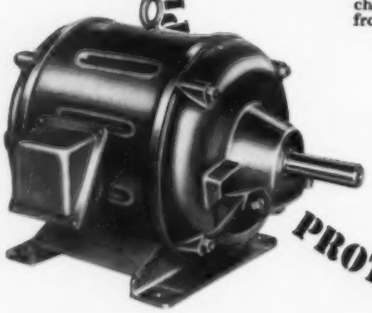


1. Wagner Totally-Enclosed Motors . . .
PROTECTED against dust, dirt, abrasives, steel chips, filings, acid fumes, and other harmful elements that may damage the windings and bearings.



2. Wagner Explosion-Proof Motors . . .
PROTECTED to prevent explosion in locations where gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors, or natural gas are manufactured, used, or handled. Approved by Underwriters' Laboratories for Class I Group D hazardous locations.

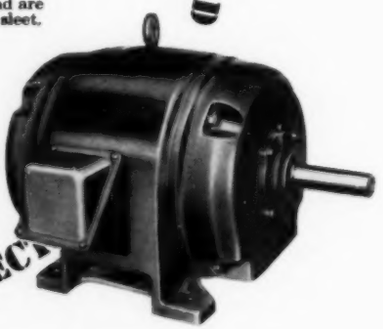
PROTECTED



3. Wagner Drip-Proof Motors
PROTECTED to keep dripping liquids, falling metal chips and other particles from entering the motor.

4. Wagner Splash-Proof Motors . . .
PROTECTED against splashing or dripping water, oil, or other liquids. They are widely used in exposed outdoor locations, and are completely self-protected against ice, sleet, snow and rain.

PROTECTED

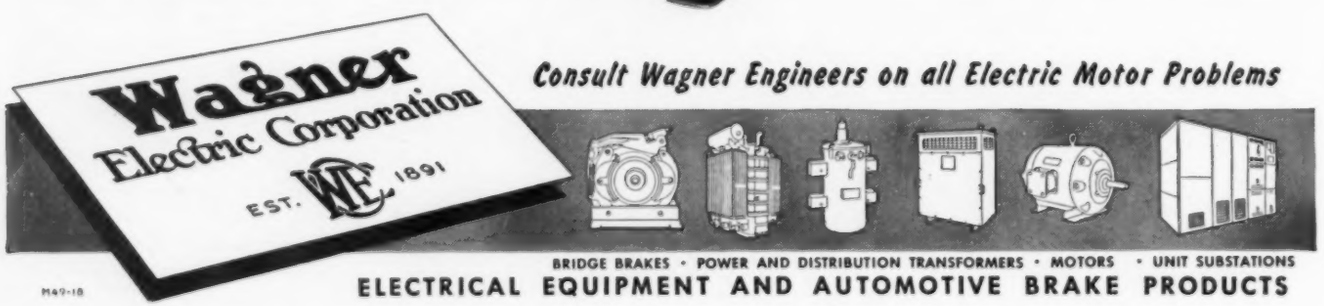


5. Wagner Chemical Plant Motors . . .
PROTECTED to resist the action of acids, fumes, moisture and other harmful elements encountered in chemical manufacturing.

PROTECTED PROTECTED

Bulletin MU-185 gives full information on the complete line of Wagner Motors. Write for your copy today.

Wagner Electric Corporation
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

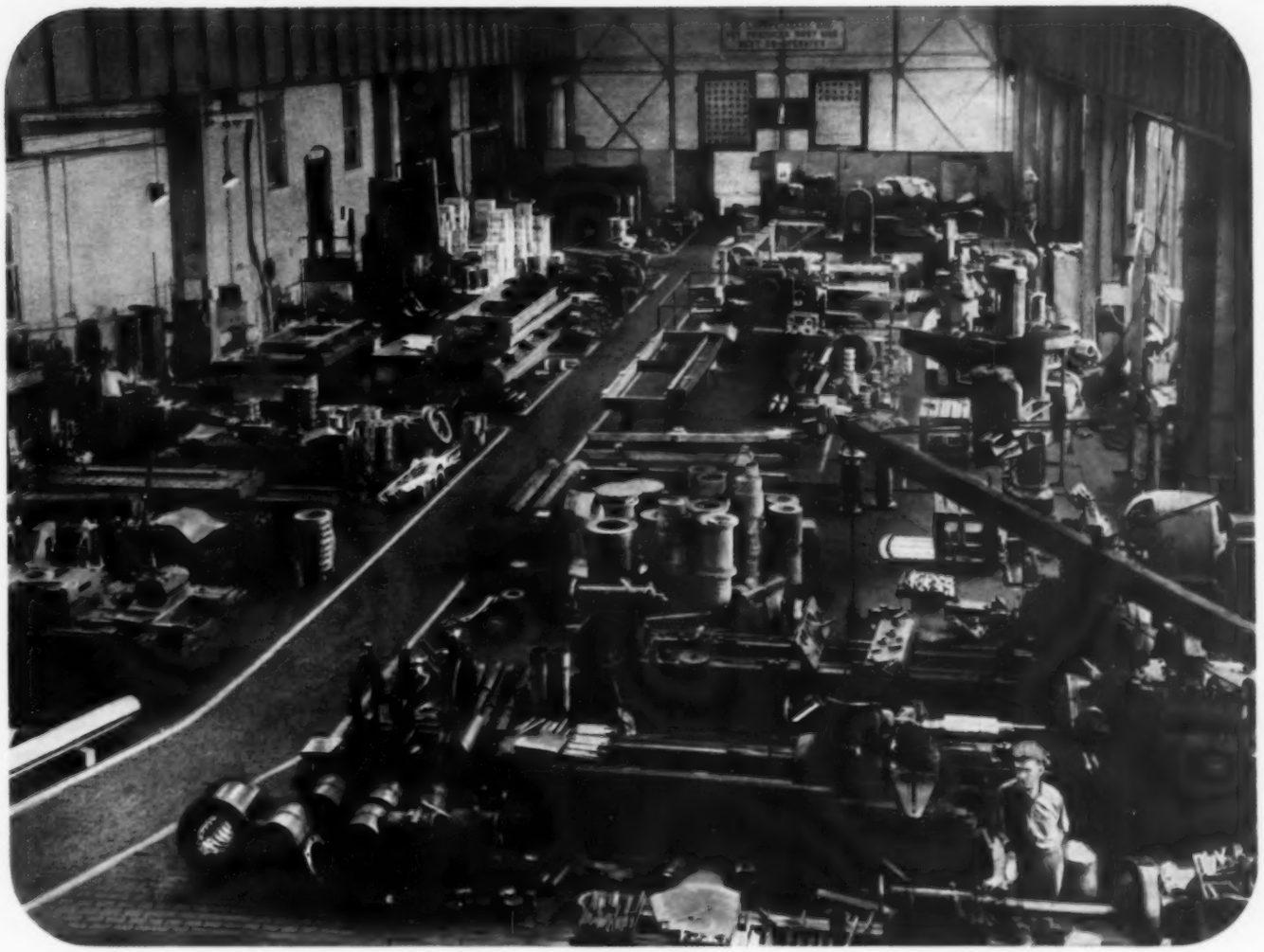


Consult Wagner Engineers on all Electric Motor Problems

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

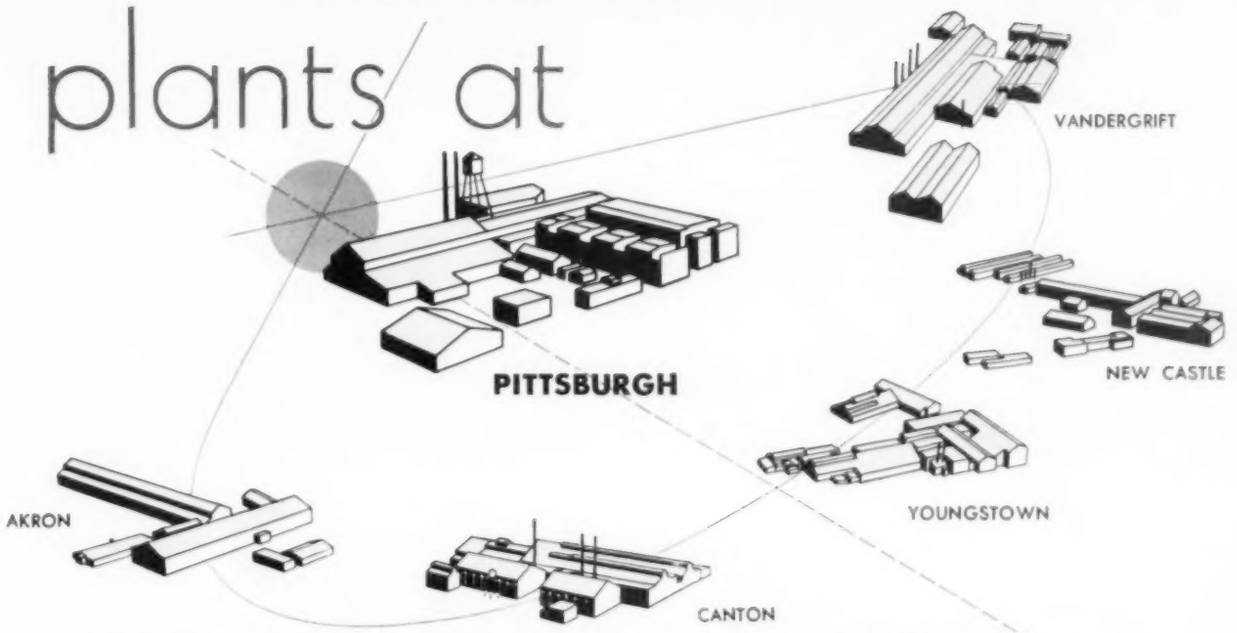
ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

M49-18



View of Machine Shop, Frank-Kneeland Plant Pittsburgh, Pa.

plants at



UNITED ENGINEERING AND FOUNDRY COMPANY

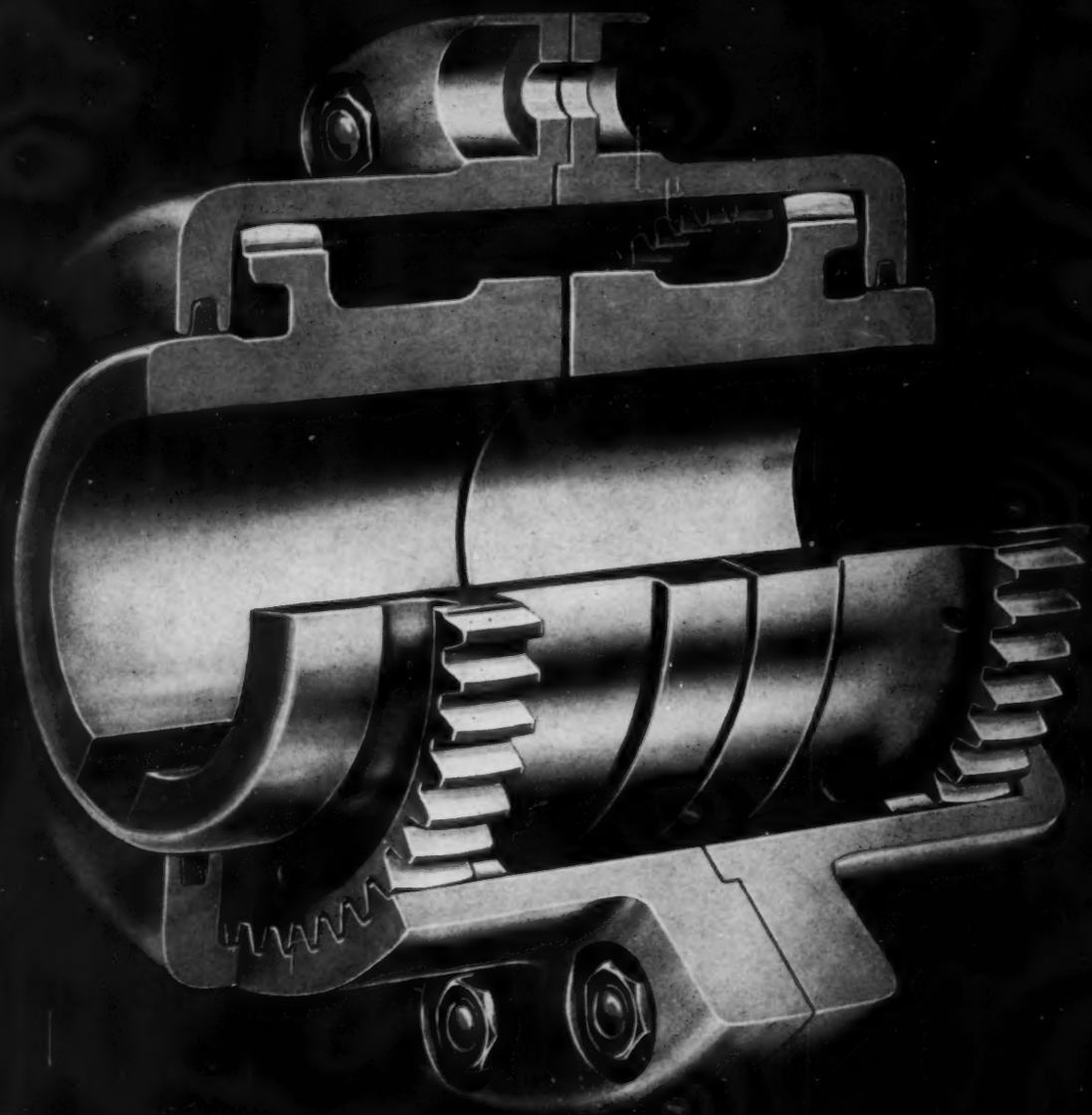
PITTSBURGH, PENNSYLVANIA

Subsidiary: **Adamson United Company, Akron, Ohio**

Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P. Q. Canada
S. E. C. I. M., Paris, France

Designers and Makers of Rolls and Rolling Mill Equipment

POOLE



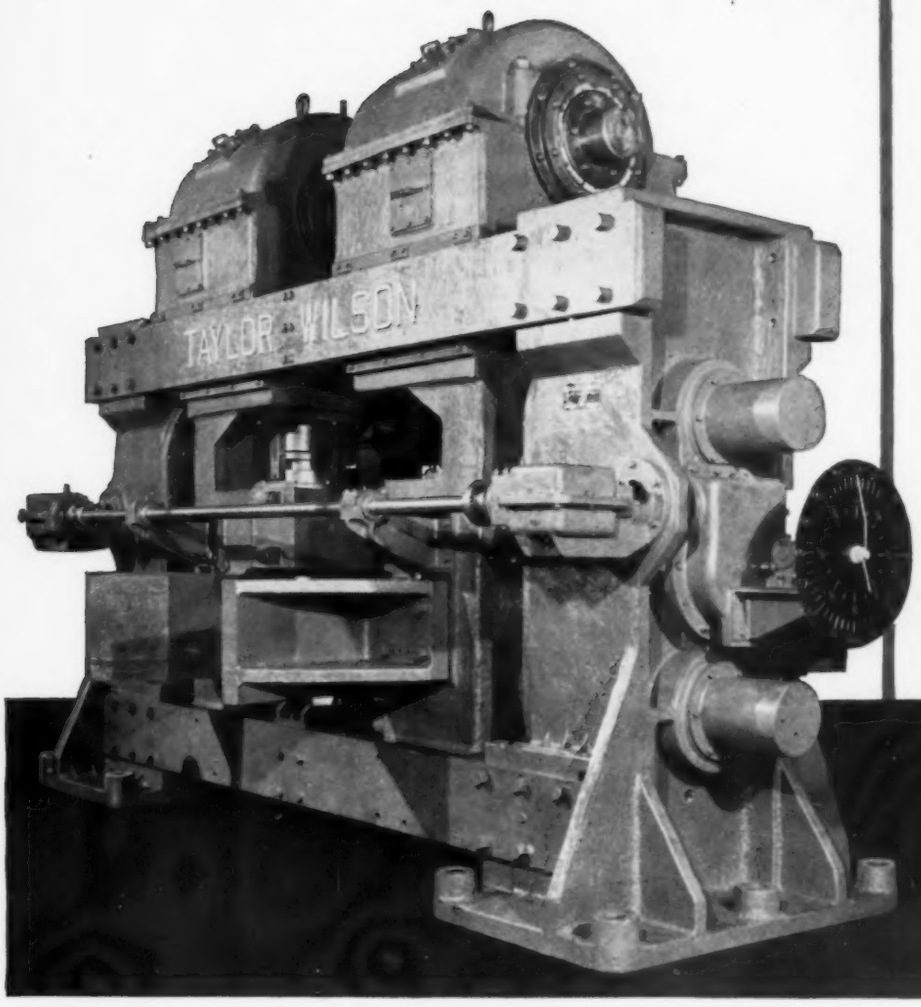
A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

GIVING A VERTICAL EDGER THE EDGE IN *Performance*



TIMKEN Tapered Roller BEARING EQUIPPED

Designed and built by Taylor-Wilson Manufacturing Company, Pittsburgh, Pa. for a large, well-known rolling mill company, this 28″ x 66″ vertical edger represents the latest development in vertical edging equipment.

To protect this machine against friction, wear, radial, thrust and combined loads and misalignment of rotating parts, and to give it the utmost economy of operation, lubrication and maintenance, Taylor-Wilson has equipped it with Timken tapered roller bearings on the roll necks and throughout the drive mechanism.

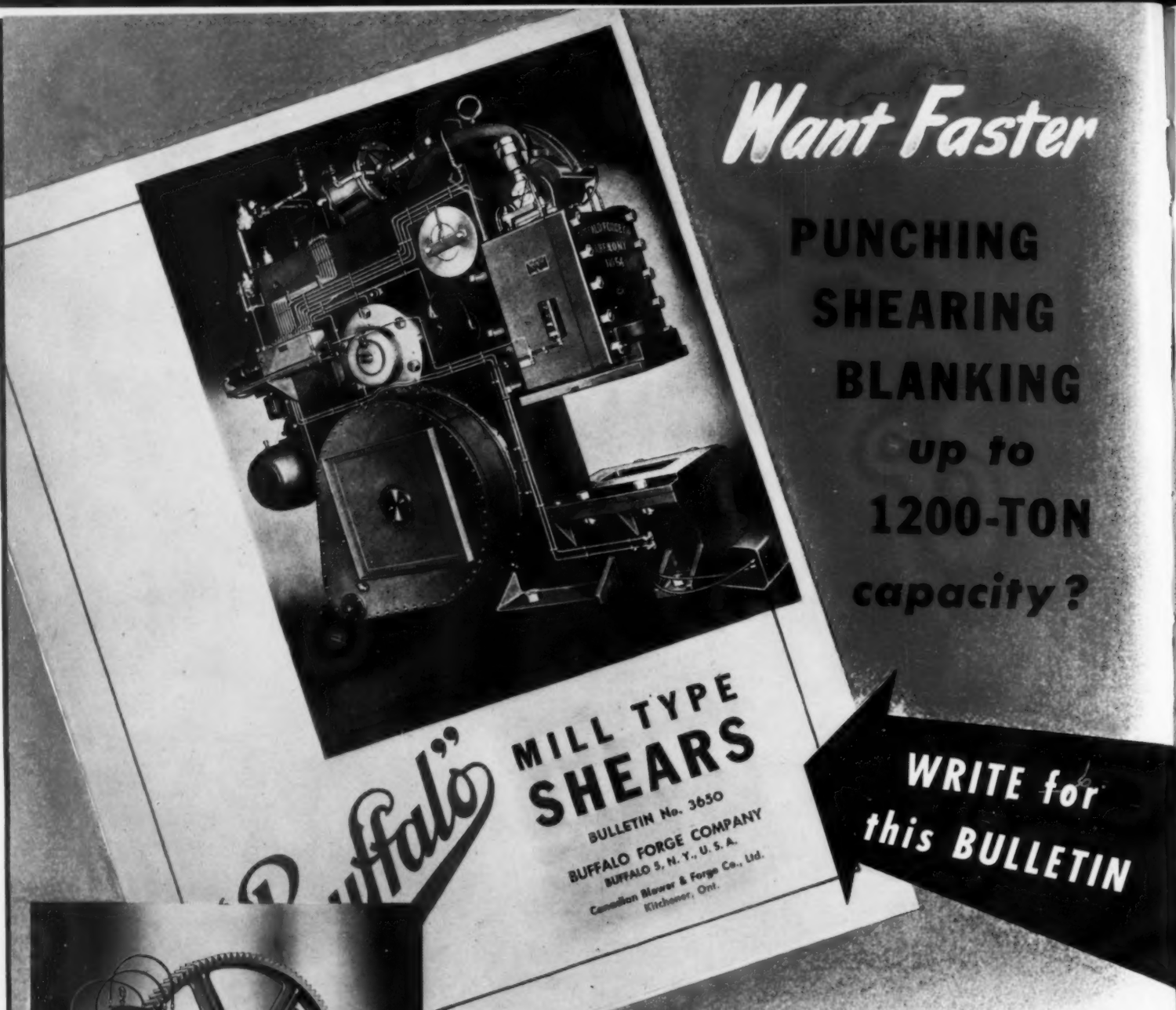
The load versatility, strength, endurance and accuracy of Timken bearings stem from (1) their advanced tapered design; (2) our 50 years of manufacturing know-how; (3) Timken fine alloy steel—the finest material ever developed for tapered roller bearings.

Whether you are building or buying steel mill machinery — any kind — you'll be ahead when you make sure you have Timken bearings.

Look for the trade-mark "TIMKEN" when buying. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address "TIMROSCO".

TIMKEN
TRADE-MARK REG. U.S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION ✳



"Buffalo" No. 51 High Stroke Mill Type Shear for bar stock with automatic air-operated Tilting Stripper. One of twelve shears to choose from to fit your operation.

- Get facts on these big-capacity machines that give 250 to 1200-ton cuts!
- Quicker tooling! Large, high space open on 3 SIDES! Up to 8″ power strokes!
- Fill the gap between the C-type punch and the four-column or straight side press.
- Ready for PUNISHMENT! Heavy electrically-welded steel plate frame provides absolute rigidity and endurance.
- Write for Bulletin 3650 for the shear that will cut YOUR punching, shearing and blanking costs!

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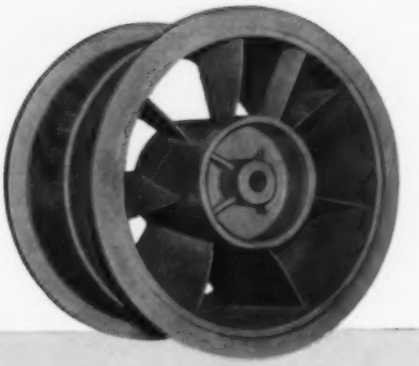
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING PUNCHING SHEARING CUTTING BENDING

ACCURACY



STRENGTH

WEAR RESISTANCE

What *Qualities* do you look for in Non-Ferrous BEARINGS and CASTINGS?

You want ALL FOUR, of course . . . and you get ALL FOUR qualities plus better performance and greater long-range economy when you specify N-B-M Bearings and Castings.

SHOCK RESISTANCE

The bearings and castings shown above are typical results of these complete—and modern—facilities that you'll find at National Bearing Division:

Research—

American Brake Shoe's extensive research labs, containing the latest in testing equipment, are always at the disposal of N-B-M for all types of research on customers' problems.

Engineering—

The N-B-M Engineering staff is fully qualified to work either for or with you in solving problems of stress, alloy or over-all design of bearings and castings.

Production—

From precision molding to final machining, N-B-M has the latest manufacturing techniques that assure you of products with maximum strength, precision, wear-resistance and density.

Quality Control—

Modern X-Ray, Photomicrographing equipment, and other latest testing devices provide a surety for you of castings that meet and often exceed your specifications.

Yes, if qualities that insure longer, more economical service are important for the Bearings and Castings used in your plant or product, call in your nearest N-B-M Representative. He will be glad to give you specific information on how this complete N-B-M service can be applied to your problems.

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AMERICAN Brake Shoe COMPANY

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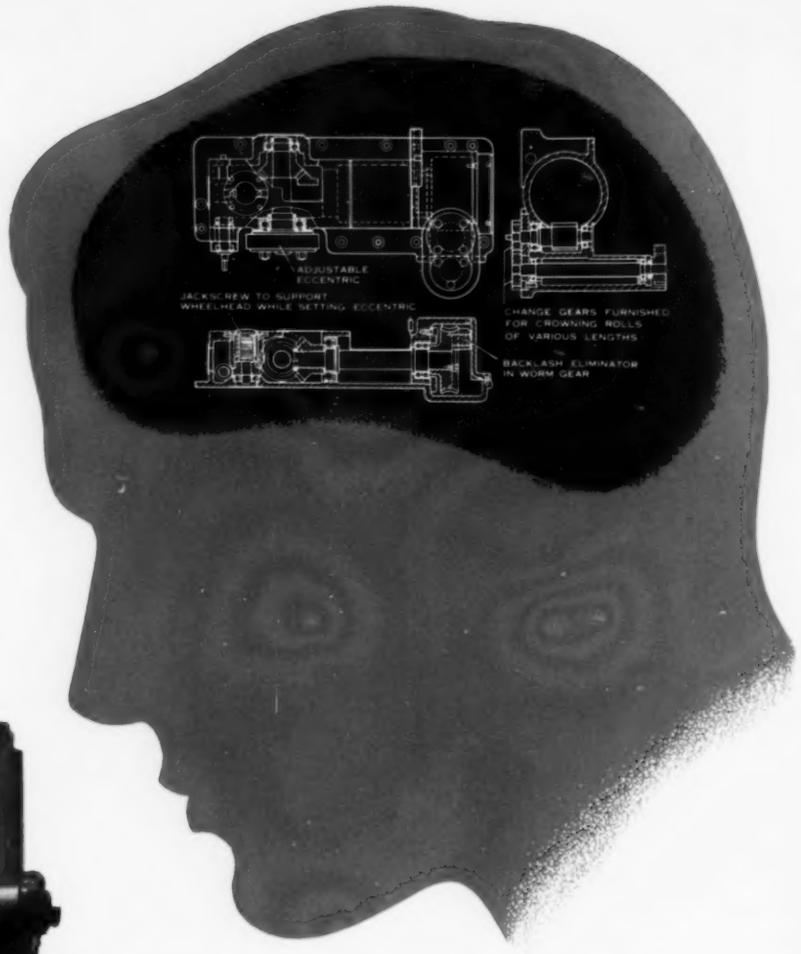
AN INFALLIBLE EXPERT . . .

at crowning or concaving rolls


ADJUSTABLE ECCENTRIC
JACKSCREW TO SUPPORT WHEELHEAD WHILE SETTING ECCENTRIC
CHANGE GEARS FURNISHED FOR CROWNING ROLLS OF VARIOUS LENGTHS
BACKLASH ELIMINATOR IN WORM GEAR

FARREL
HEAVY DUTY ROLL GRINDER
FARREL-BIRMINGHAM CO., INC., ANSONIA, CONN.
Please send me, without cost or obligation, a copy of your Bulletin No. 115, "FARREL HEAVY DUTY ROLL GRINDER."
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Farrel roll grinders have a patented, automatic crowning and concaving device, a built-in "brain," which guides the grinding wheel along a perfectly graduated, mathematically accurate curve.

The curve produced is of the correct shape for a crowned or concaved roll, exactly symmetrical on both halves of the roll. The same setting invariably results in exactly the same curvature, and permits fixed, uniform and easily controlled accuracy of contour in all rolls.

Of the adjustable, single eccentric type, the device is designed for ease and simplicity of setting and produces the curvature desired without any manipulation on the part of the operator. The eccentric and change gears are readily accessible so that settings for any curve can quickly be made.

This is only one of the many outstanding advantages of Farrel heavy duty roll grinders. For the complete story, send for a copy of Bulletin 115. Just fill out the coupon and drop it in the mail.

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Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston

Farrel-Birmingham

FB-518

Shown here is a 250-ton push-pull, screw-type Stripper crane, used for stripping both small end-up ingots, and large end-up ingots with hot tops. An added feature for faster handling is the retractable bull nose; with this, no adjustments are necessary when stripping ingots of various types and sizes. Alliance builds this Stripper crane in various capacities up to 800 tons, with a safety factor of 5. If your installation does not warrant a stripper of this kind, ask us about our impact stripper, which makes use of the most reliable of all forces, gravity. The Alliance Machine Company builds all types—all sizes—to move heavy loads safely, quickly, economically. Always rely on Alliance to give your plant dependable, extra lifting power.

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Need rolls for your tin plate, strip or sheet mill . . . for rolling precious metals, copper, aluminum . . . synthetic materials? Look to Midvale if you want hardened and ground forged steel rolls built to your own high standard of quality. Midvale rolls are superior rolls—as your experience will prove. The reason—Midvale workmanship, care and knowledge, all contribute to the finished product. The Midvale Company, Nicetown, Philadelphia.

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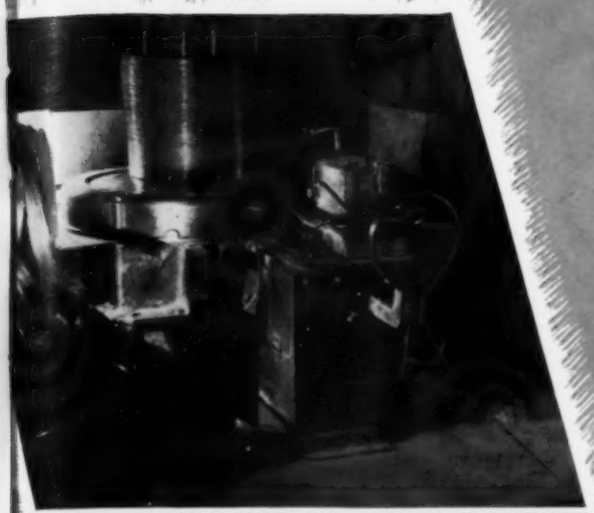

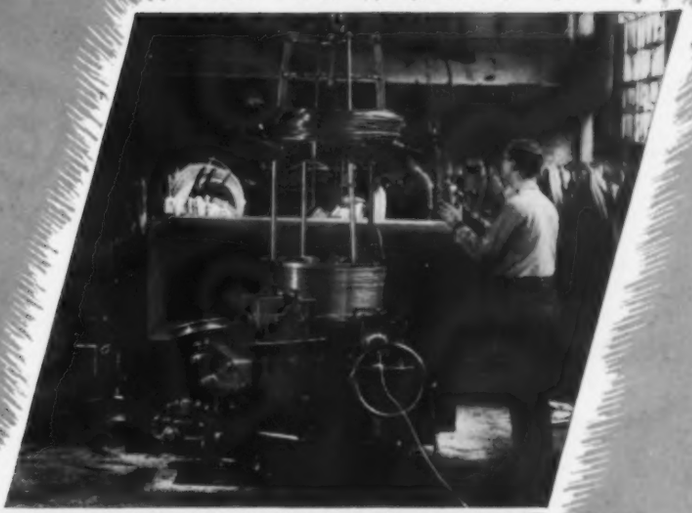

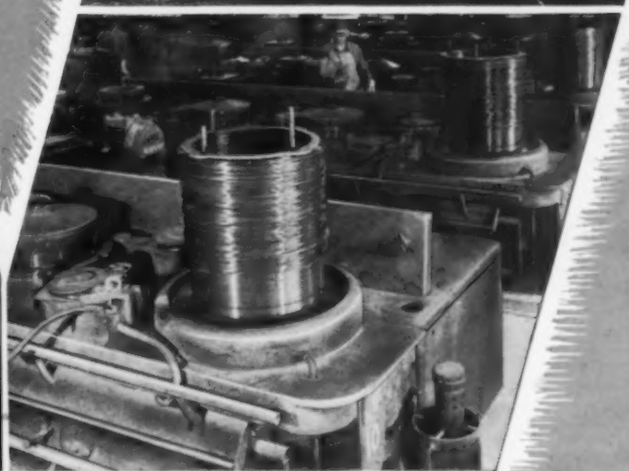

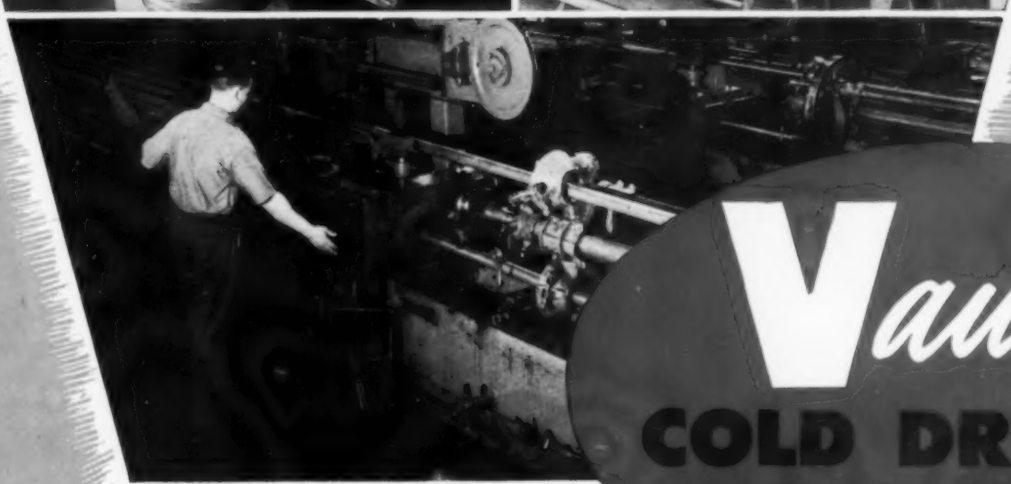

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RIGHT IN TYPES, SIZES AND CAPACITIES FOR EVERY HIGH PERFORMANCE COLD DRAWING APPLICATION IN THE METAL INDUSTRIES

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Quick on the Draw!

VAUGHN MACHINERY

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COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

high-speed rod and merchant mill uses amplidyne control -to help roll a wider variety of products!

Shown in this merchant-mill motor room are 6 of 13 G-E main-drive motors, rated 100 to 800 hp. The 4000-kw motor-generator set in the rear is driven by a 5600-hp, 514-rpm synchronous motor.

General Electric-engineered drive provides simple, flexible operation—helps roll more steel!

Add this as another example of steel mill drives equipped and co-ordinated by General Electric for modern, high-speed operation. It's the main drive recently installed in a large midwestern rod and merchant mill to roll billets into shaped steel products.

Accurate Speed Adjustment!

Driving its 15 stands are 13 main-drive motors in two groups. Each group is powered by a separate generator, with its voltage separately controlled by an amplidyne exciter. By providing a speed differential between groups of motors, a greater variety of products can be rolled.

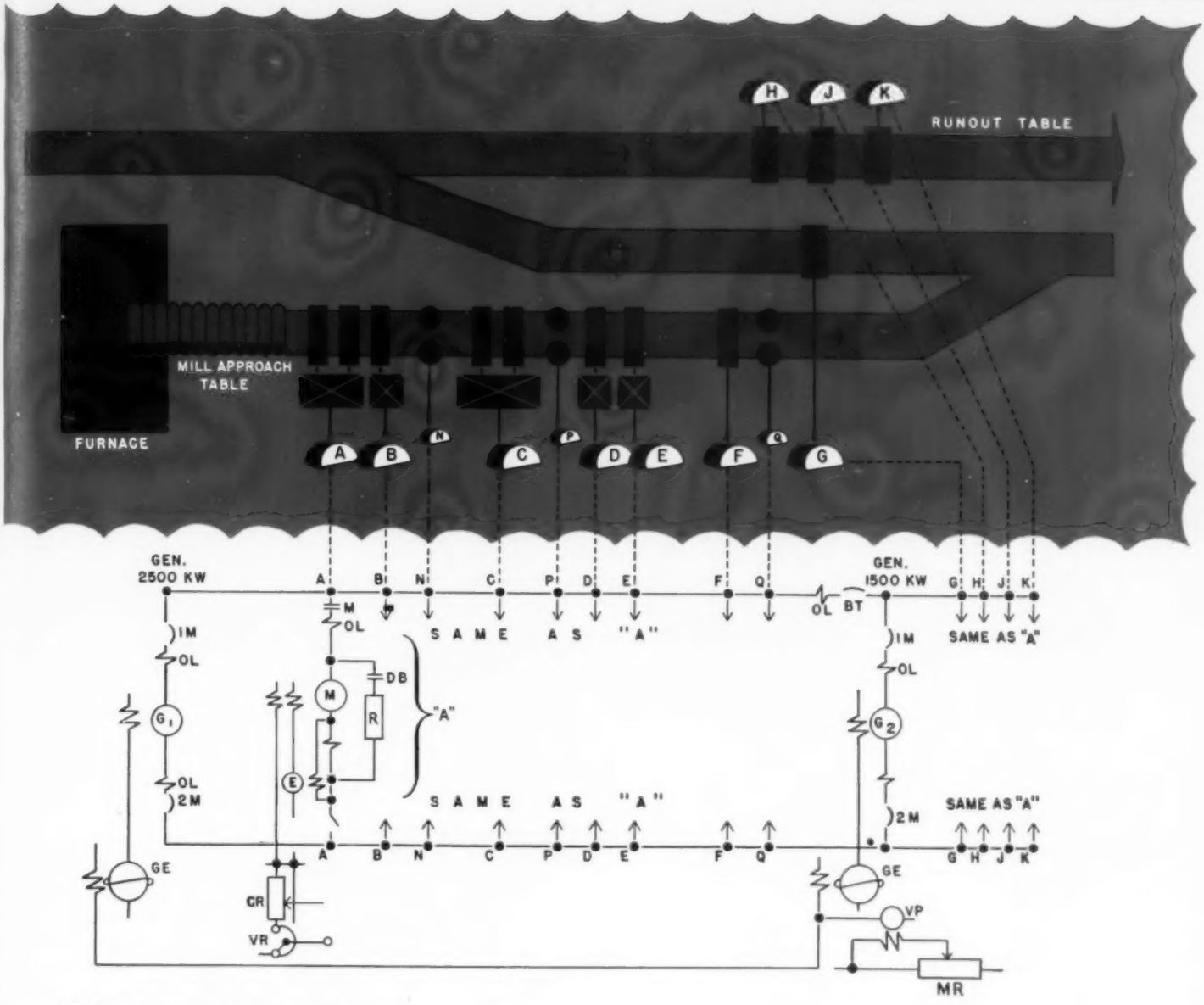
Close Speed Regulation!

In addition, special characteristics built into the main-drive motors maintain a close, steady-state speed regulation, and minimize speed changes in each stand under sudden load changes. Thus, without speed regulators or electronic circuits, this drive provides simple fingertip control, requires less maintenance, helps roll more tons of good steel.

This installation—which also includes complete electric equipment for many auxiliaries—illustrates an important point: To serve the steel industry, General Electric couples experienced engineering skill with extensive manufacturing facilities. That's why you save time, trouble, and expense on drive problems when a G-E steel-mill specialist works with your technical staff. Why not call him at your nearest G-E office? ***Apparatus Dept., General Electric Company, Schenectady 5, New York.***

GENERAL ELECTRIC

659-60



In brief, here's how it works—

In the control circuit shown, the 13 main-drive motors (A thru K) are connected to two generator bus sections—one bus section being supplied with power by a 2500 kw—600 V generator (G1); the other being supplied with power by a 1500 kw—600 V generator (G2). The two generators may be operated at different voltages when the products being rolled require more than normal speed differential between the two groups of motors, or operated in parallel at the same voltage if schedules permit.

Voltages of both generators are automatically regulated to a predetermined value by the amplidyne generator exciters (G-E). The voltage is determined by the motor-operated rheostat in the field of the voltage pilot (VP).

The main shunt field of each stand motor is controlled by a motor-operated coarse-adjusting rheostat (CR) and a hand-operated vernier rheostat (VR). The auxiliary shunt field of each is excited by a series exciter (E) which measures the motor-load current and excites the motor auxiliary shunt field to maintain a steady-state speed regulation of not over 1½% at full load and full voltage.

Special transient-speed characteristics are built into the main stand motors (A thru K) to minimize the change in speed of each stand as the load suddenly changes.

another example of
GENERAL ELECTRIC
drive engineering
at work!

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Under all conditions the proved performance of Tycol lubricants more than meets their recommended service.

Rigidly controlled and tested during manufacture . . . and refined from the highest grade crudes, Tycol oils and greases are known for their *UNIFORMITY within each classification — from the first drum to the last.

This unvarying high quality, plus the scope of the line, accounts for Tycol's wide acceptance by industry interested in maximum production . . . top efficiency . . . lowest operating cost.

Whatever your lubrication need, let a Tide Water Associated engineer help you select the one suited for your particular need. Call, write or wire your nearest Tide Water Associated office for full details.

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*LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA"

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WHITCOMB DIESELS are five times first choice with SCULLIN STEEL

A compact, powerful Whitcomb 50-ton Diesel locomotive delivers inbound cars of scrap and materials to the 100-acre plant of Scullin Steel Company, St. Louis, famous throughout industry for fine quality steel castings.

AT SCULLIN STEEL, famous for its rugged steel castings, five compact, powerful Whitcomb Industrial Diesels serve as important, highly integrated tools of production, not only delivering inbound cars of scrap, lime and sand, but also charging the open hearth furnaces with melting scrap.

The first three Whitcomb 50-ton Diesels replaced five steam locomotives at Scullin Steel. The fourth 50-ton Whitcomb was added in 1942. And, in 1943, a 65-ton Whitcomb joined the Whitcomb fleet.

The best recommendation for any product is a satisfied customer. And Whitcomb customers include many who have purchased not just one but several Whitcomb Diesels over the years — a convincing testimonial to the power, dependability, economy of Whitcomb Diesel locomotives.

There is a Whitcomb Diesel electric or Diesel mechanical locomotive for every requirement, in various sizes, gauges and weights ranging from 3 to 95 tons. Write today for complete information, and learn the many ways that industry is using Whitcomb Diesels for faster, lower-cost handling of materials, freight and production.

High availability of their five Whitcomb Diesels assures a steady flow of scrap to Scullin furnaces.

Hauling sand, lime, scrap and castings makes a 24-hour job for this 50-ton Whitcomb Diesel.

There is no power cheaper than Diesel; no locomotive finer than a Whitcomb.

THE BALDWIN GROUP

THE WHITCOMB LOCOMOTIVE CO.

ROCHELLE, ILLINOIS

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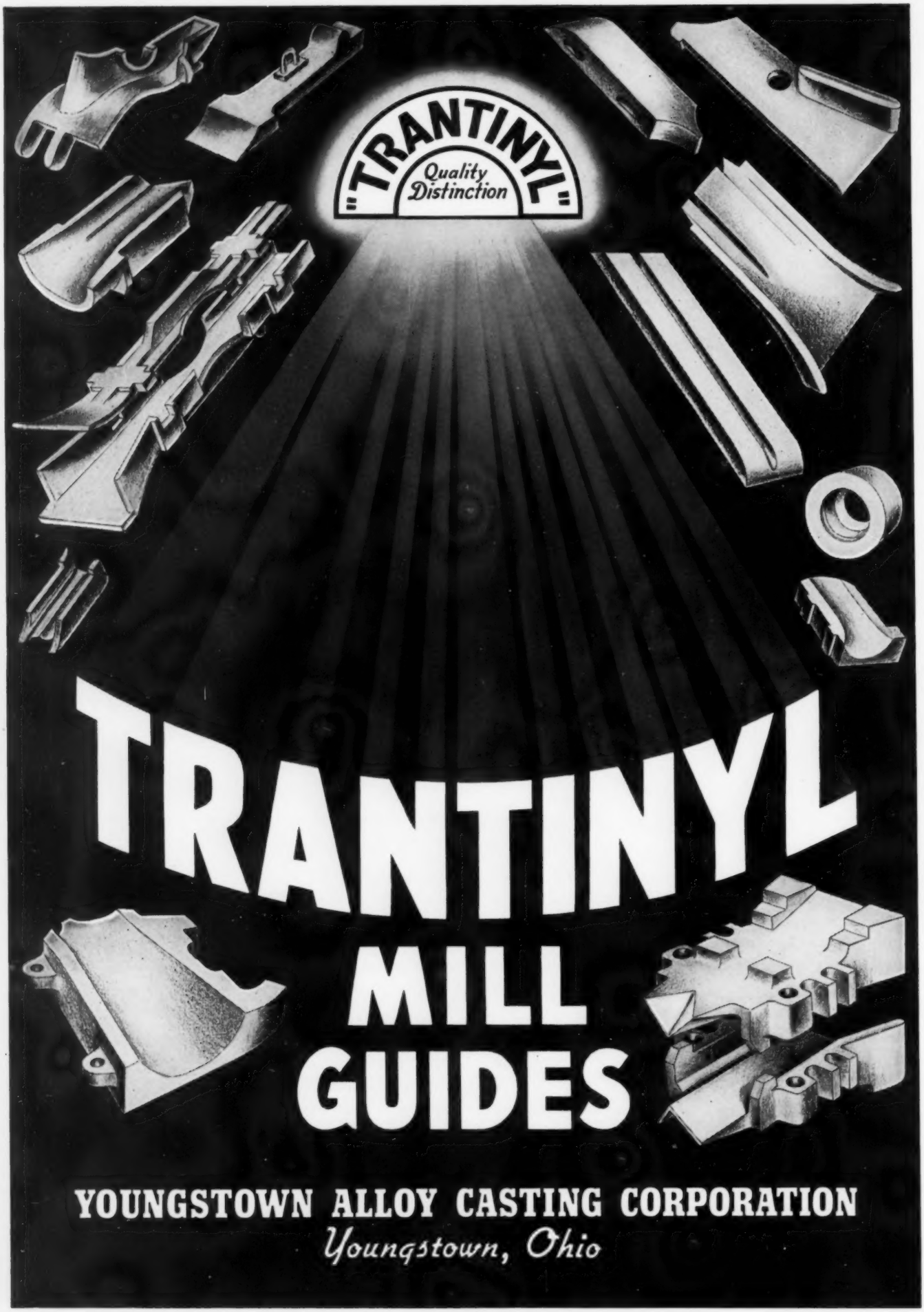
THE BALDWIN LOCOMOTIVE WORKS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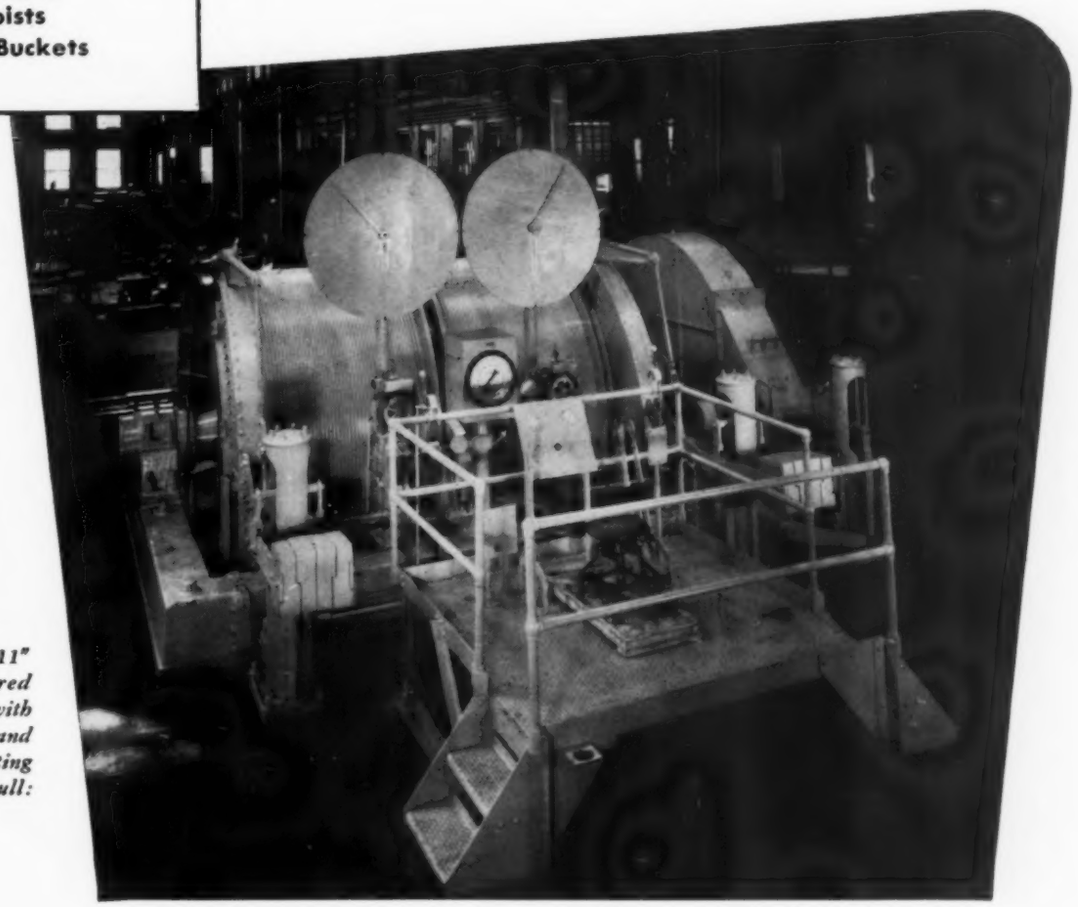
Wellman Electric Mine Hoists

Proved by performance



Wellman 10' x 4' 11" Double Drum Geared Electric Mine Hoist with 7' axial plate clutch and 10' x 13' Parallel Acting Brakes. Rated rope pull: 22,000 lbs.

● For more than half a century, in mines all over the world, Wellman Electric Mine Hoists have been used because they combine expert design with expert construction . . . featuring all the "modern improvements" developed in our 50 years' experience. Wellman Mine Hoists provide maximum safety, peak economy, and trouble-free operation under a wide variety of conditions. Let us give you recommendations for hoists that will do your job most satisfactorily.

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TWO TYPES OF FLEXIBLE COUPLINGS—ALL THAT ARE NEEDED TO MEET EVERY SERVICE CONDITION.

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For high speeds or heavy-duty, gear up for direct, free and consistent transmission of power with *Amerigear Flexible Couplings*.

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For low speeds, and a factor of greater protection against destructive damage to driven mechanisms, use *American Flexible Couplings*—the only couplings with a floating center member equipped with replaceable bearing strips.

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AFFILIATE OF J. A. ZURN MFG. CO.
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AMERICAN *Flexible Couplings*

AMERICAN FLEXIBLE COUPLING CO.
Dept. ISE, Pittsburgh Avenue, Erie, Pa., U. S. A.
We Are Seeking Power Transmission At Its Best. Please send:

☐ **Booklet "Relief from Bearing Wear Grief".**
☐ **American Flexible Couplings Catalog No. 41.**

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Company_____
Address_____

EVEN THE PRESIDENT ISN'T WORRIED!

WITH WATER REPELLING LEADOLENE IN THE SYSTEM!

Certainly, Lubrication Dan could pour water on this mill forever and "LEADOLENE" would keep right on providing perfect protection.

Unlike ordinary mineral oils, "LEADOLENE" sheds water and always stays neutral—*never becomes acid.* Because of its indestructible pH-ilm it prevents metal to metal seizure and keeps gears from pitting, cutting and excessive wear. If you've been "getting by" with ordinary mineral oils and your system is now showing signs of sludging or excessive wear on the pinions or gears, it's time to call in the Brooks engineer and end the threat of a costly shutdown.

**LEADOLENE... the "I.P. Lubricant" ("Indestructible pH-ilm)... for Industrial Needs*

The Brooks Oil Co.

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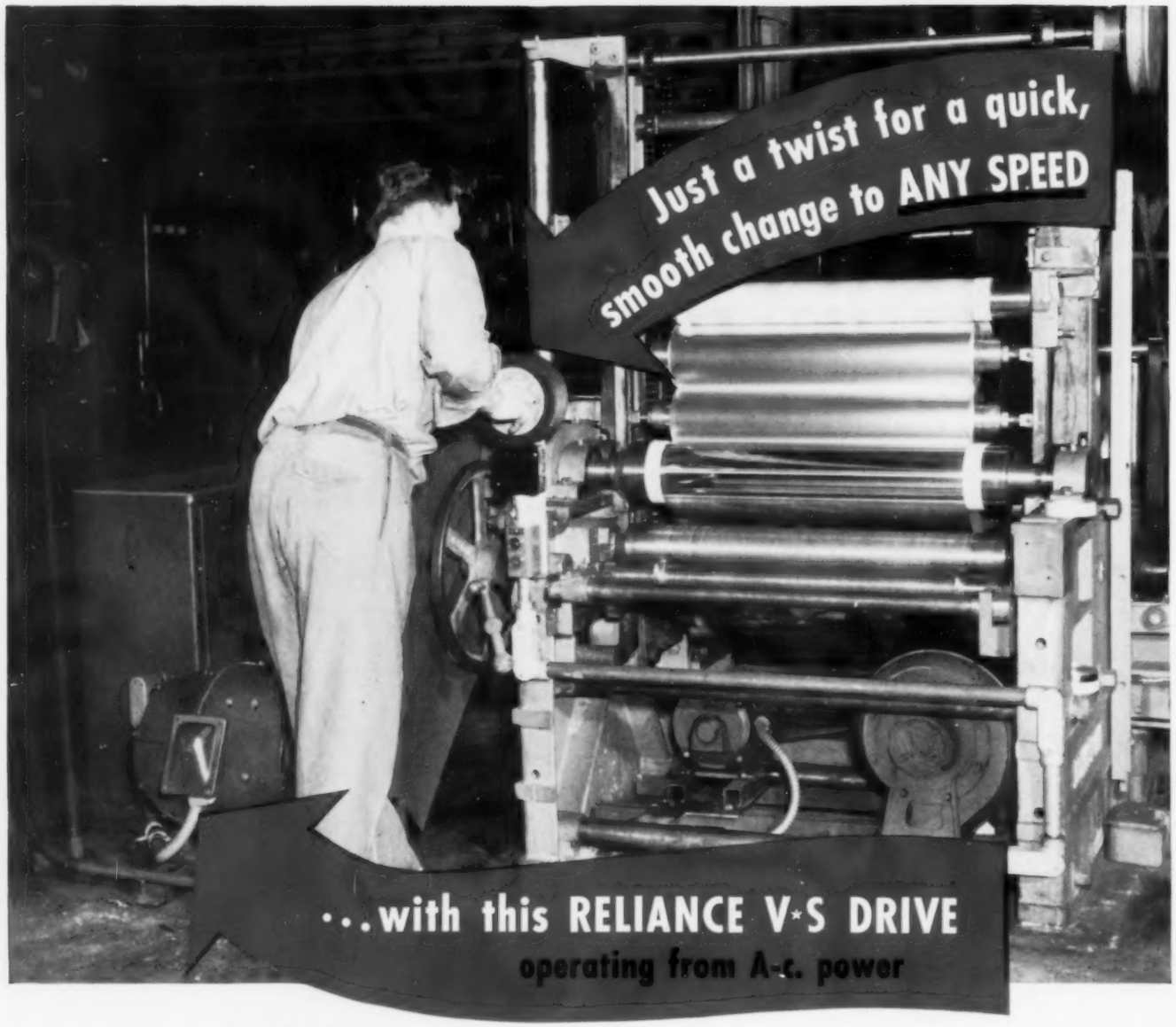
Warehouses: In Principal Industrial Cities



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Conveniently-packaged, factory-wired V★S Drives are available from 1 to 200 hp. Two or more motors may be operated simultaneously from a single Control Unit.

Turning the Speed Adjustor of a Reliance V★S Drive produces *any* speed required to make a machine do its best at *any* point in *any* process. Control may also be automatic—and located at the machine or at any remote station. Quick, smooth starting, stopping and speed changing may be supplemented by inching or jogging—maintenence of proper tension, reversal at any point and many other functions. Whatever flexibility *you* need to increase production and lower costs is here—in the original, packaged All-electric Drive. It will operate directly from your plant's A-c. circuit. Write today for *new* Bulletin 311 which offers further important details.

Sales Representatives in Principal Cities

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Continental's Progressive Engineering BUILDS TODAY'S FINEST HIGH YIELD Rolling Mills and Equipment

"Progressive Engineering" is Continental's term for a design practice which applies *trained imagination* to the engineering of advanced rolling mills and accessory equipment. Continental offers you engineering that uses accepted standards only when proved best—applies advanced principles that give you cost-cutting operations. Even though you have never had a recommendation from Continental before—start *now* to consider Continental one of your logical *first sources!* Many of America's greatest steel and non-ferrous mills are Continental equipped!

Check first with Continental!

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Structural Mills	Slabbing Mills	Non-Ferrous Mills
Bar & Billet Mills	Universal Mills	Roll Lathes
Merchant Mills		Shears (all types)

and other Steel Plant Equipment and Special Machinery

CAST IRON, ALLOY IRON AND STEEL ROLLS
CARBON AND ALLOY STEEL CASTINGS to 250,000 lbs.

Continental

Continental
FOUNDRY & MACHINE CO.
CHICAGO • PITTSBURGH
Plants at East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.

PARALLOY

REGISTERED TRADEMARK

PINCH ROLLS
COILER ROLLS
TENSION ROLLS
STEEL MILL ROLLS

LIST OF PRODUCTS

HYDRAULIC SLAB AND BILLET PILERS

STRIP AND SHEET OILING EQUIPMENT

SHEET SCRUBBER AND CLEANING LINES

HOT SAWS — ROCKING AND SLIDE TYPES

HOT BEDS — COOLING BEDS — TRANSFERS

BILLET EJECTORS — PINCH ROLL STANDS

SLITTERS — SPECIAL SHEARS AND GAUGES

TILTING TABLES — TRAVELING AND LIFTING TABLES

CONTINUOUS PICKLING LINES — ROLLER LEVELLERS

FURNACE CHARGING EQUIPMENT — FURNACE PUSHERS

STRIP STEEL COILERS AND REELS — SCRAP BALLERS

RAILROAD SPIKE FORMING MACHINES — ROLL LATHES

SHEET GALVANIZING LINES — WIRE PATENTING FRAMES

STRETCHER LEVELLERS — ANGLE AND SHAPE STRAIGHTENERS

ROLLING MILL TABLES — GEAR AND INDIVIDUAL MOTOR TYPES

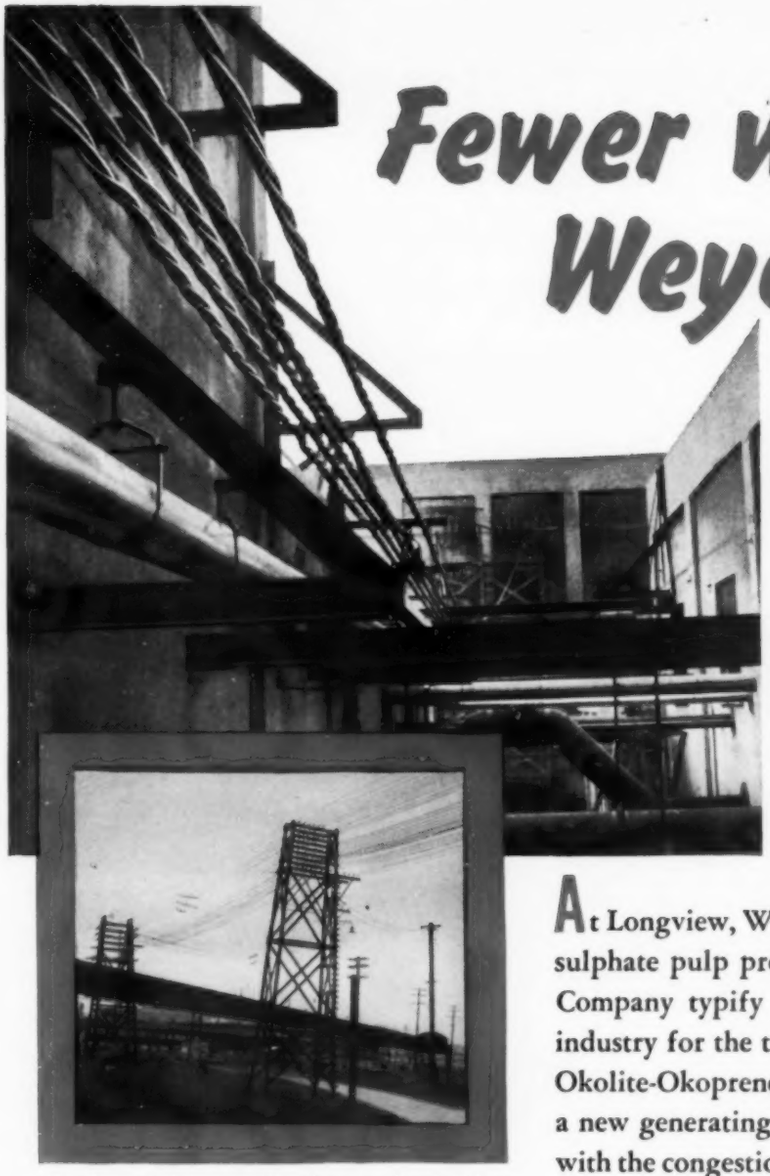
MACHINERY BUILT TO CUSTOMER'S

DESIGN AND DETAIL DRAWINGS

The Youngstown Foundry & Machine Co.

YOUNGSTOWN, OHIO

Fewer wires for Weyerhaeuser!



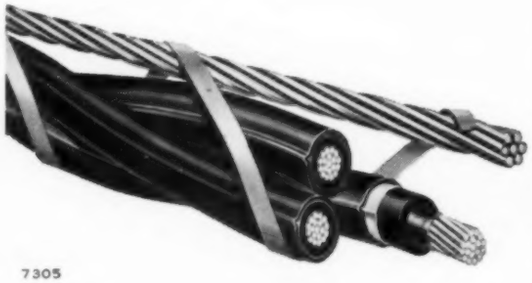
. . . space saved
. . . installation cost lowered
. . . all-weather dependability assured with

OKOLITE-OKOPRENE SELF-SUPPORTING AERIAL CABLE

Contrast the congestion shown in lower picture with the compact, simple installation of Okolite-Okoprene Self-Supporting Aerial Cable (above) at Weyerhaeuser's new pulp mill at Longview, Wash. Recently-erected generating plant is in background. Installation was made by Western Electrical Construction Co., Portland, Oregon.

At Longview, Wash., the new MgO sulphite recovery and new sulphate pulp processing plants of the Weyerhaeuser Timber Company typify the advantages of self-supporting cable in industry for the transmission and distribution of power. Here, Okolite-Okoprene Self-Supporting Aerial Cable serves between a new generating plant and an old one. It contrasts strikingly with the congestion of open wiring.

With Okolite-Okoprene Self-Supporting Cable, *self-evident space economy* is matched by installation economy as it requires no separate stringing. Further savings result from the long life of this storm-safe all-weather cable assembly.



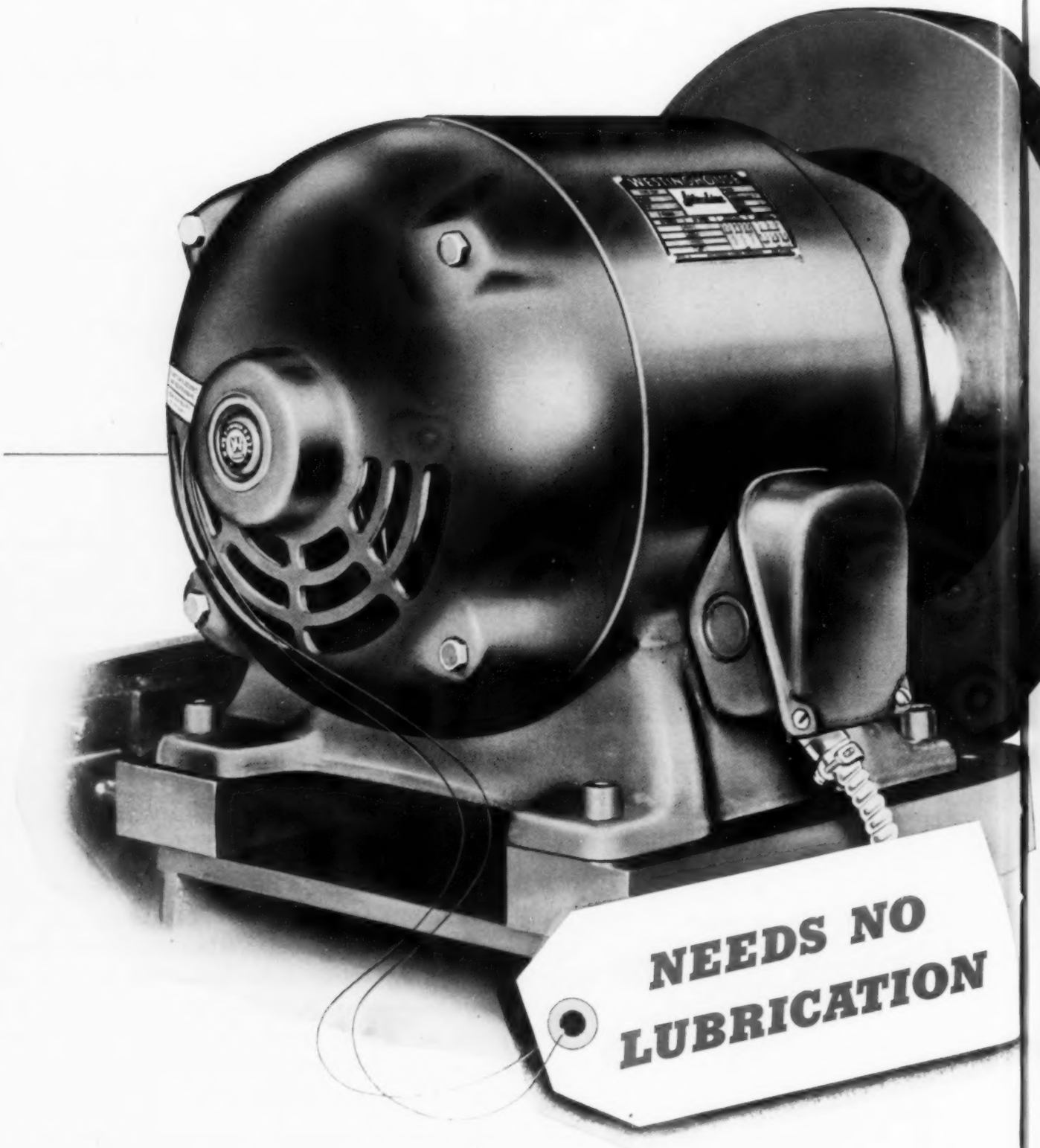
7305

Another feature of Okolite-Okoprene Self-Supporting Cable that makes it valuable in industrial plants is this fact: *safe as well as easy* handling is assured. The cable is fully insulated with Okolite high-voltage moisture and heat-resisting insulation and protected with weather-resistant non-conducting Okoprene. For 52-page Self-Supporting Cable book available to electrical engineers and plant executives, please address The Okonite Company, Passaic, N. J.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 insulated wires and cables

Based on Bearing Performance Records



Westinghouse

says

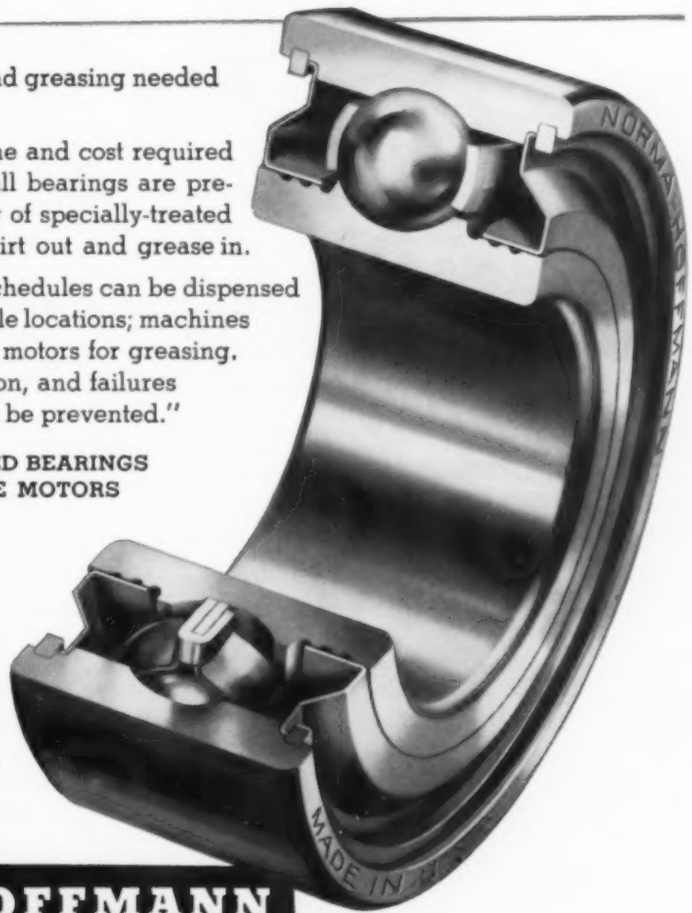
"do away with lubrication costs"

IN THEIR LIFE-LINE MOTORS

"Forget old-time ideas about the care and greasing needed to keep motors running!

"Life-Line motors now eliminate the time and cost required for lubrication. Life-Line double-width ball bearings are pre-lubricated with a more-than-ample supply of specially-treated lubricant — and factory-sealed to keep dirt out and grease in.

"Periodic weekly or monthly greasing schedules can be dispensed with. Motors may be installed in inaccessible locations; machines no longer need be disassembled to reach motors for greasing. Winding failures caused by overlubrication, and failures caused by use of improper lubricants, can be prevented."



NORMA-HOFFMANN "CARTRIDGE" SEALED BEARINGS ARE USED IN WESTINGHOUSE LIFE-LINE MOTORS

With their extra large initial grease supply, made possible by their double width and with highly efficient seals insuring against grease leakage, Norma-Hoffmann "Cartridge" bearings give years and years of service without relubrication. They are prepacked with a carefully metered volume of oxidation-resistant and wide temperature range grease.

Whether you are building motors, machine tools, pumps, fans or other equipment, let our Engineers show you how you may eliminate lubrication costs and simplify your designs by using these "neglect proof" Cartridge ball bearings.

NORMA-HOFFMANN
***Precision* BEARINGS**
BALL • ROLLER • THRUST

NORMA-HOFFMANN BEARINGS CORPORATION • Stamford, Connecticut

"...galvanized conduit corroded"

so they switched to

ROCKBESTOS A.V.C.

Inner protective impregnated asbestos wall
High dielectric varnished cambric tapes
Outer protective impregnated asbestos wall

THE AVC SANDWICH

High dielectric tapes sealed from air by two asbestos insulating walls.

Where moisture, fumes and heat corroded galvanized conduit, a large Mid-western electric utility replaced ordinary rubber covered cables with this Rockbestos AVC.

The circuits were in a damp, low ceiling basement area adjacent to open ash hoppers and exposed to ash discharge belt conveyors. Moisture, heat, sulphur and other coal gasses corroded the galvanized conduit before it was covered with asphalt paint.

This company chose and installed Rockbestos AVC because its impregnated felted asbestos insulation forms impervious barriers protecting the high dielectric varnished cambric tapes from conditions that destroy ordinary insulations.

Another case where "low-cost" cables cost more in the end . . . where a switch to ROCKBESTOS AVC meant dependability—and *true economy*. Rockbestos AVC is doing the job.

You'll want to know the full Rockbestos Story — Write.

ROCKBESTOS PRODUCTS CORPORATION
NEW HAVEN 4, CONNECTICUT

NEW YORK CLEVELAND DETROIT CHICAGO
PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CALIF.

WIRES and CABLES by

ROCKBESTOS

....dare to be better

SPEAKING OF ACCEPTANCE

63 Morgan Billet Mills

are here... in the largest producing plants of this country turning out greater tonnages . . . Morgan's skill has been proven at home.

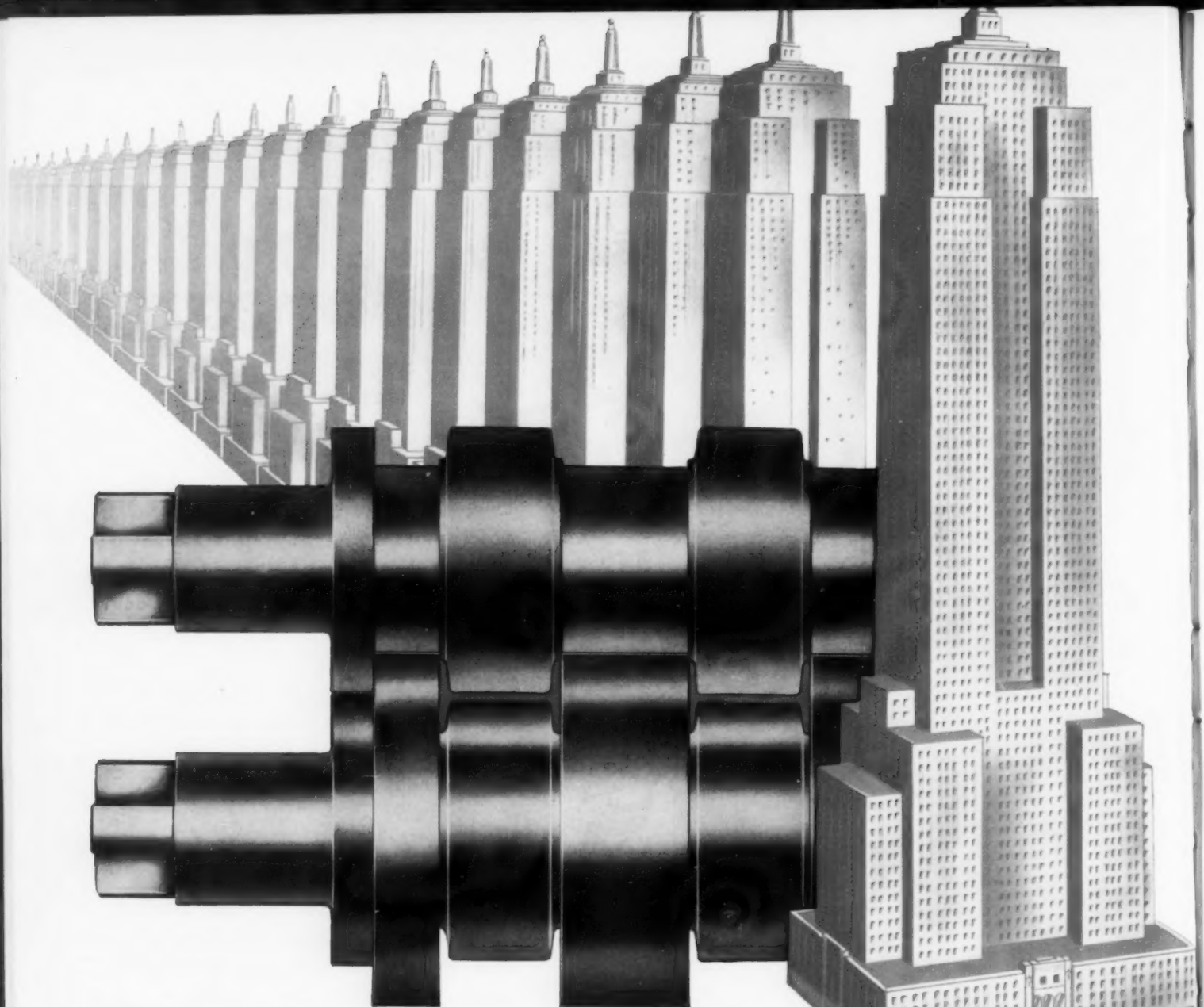
there... in steel producing countries outside the U. S. . . . proving the value of Morgan experience gained in 60 years of Billet Mill construction.

everywhere... with **63** Continuous Billet Mills constructed or in the process of construction . . . the technical ability of Morgan engineers, applied to *your* problem, means more profitable production for you.

RM-11

MORGAN CONSTRUCTION COMPANY
WORCESTER, MASSACHUSETTS
Rolling Mills - Wire Mills - Gas Producer
Machines - Regenerative Furnace Control

English Representative :
International Construction Co., 56 Kingsway, London, W. C. 2, England



More than 80 Empire State Buildings could be built with Structural Shapes Rolled last Year

P.R.W.

NEW YORK'S Empire State Building contains approximately 60,000 tons of structural shapes. Approximately 80 such structures could be built with last year's total production of some 4,800,000 tons . . . much of it passed through rolls with the famous P. R. W. mark on the end of the wabbler.

Pittsburgh Rolls makes rolls for every stand and for every shape; rolls that are *right* in hardness, *right* in tensile strength, *right* in resistance to side wear, *right* in design. Into each Phoenix Roll is built the metallurgical knowledge of people who combine long experience with ceaseless study. Naturally—less cost per ton of steel rolled.

PITTSBURGH ROLLS • Division of Blaw-Knox Company • Pittsburgh 1, Pa.

PITTSBURGH ROLLS

LINCOLN
LUBRICATING
SYSTEMS

This 28 inch reversible hot strip mill (in process of manufacture) will be equipped with a Lincoln Centro-Matic Lubricating System.

Standardized MASS LUBRICATION

for the economical operation of mass machinery

Many large steel producers have found that it is sound economy to equip for the mass lubrication of mass production machinery. All bearing points are lubricated automatically from one central source as part of one standardized system of lubrication. The strip mill shown above, with more than 400 lubrication points, is being equipped with the famous Lincoln Centro-Matic Lubricating System. This centralized system assures the user a higher rate of production with less down time and will prevent lost manhours and excessive power consumption—factors that add up to Lower Operating Costs.

Lincoln's expert lubrication consultants will gladly work with you and recommend the Lubricating System best suited to meet your requirements. Call your Lincoln Distributor or the Sales and Service Office nearest you. Copies of Bulletins on Lincoln Centro-Matic Systems and Catalog No. 63 will be sent upon request.

SALES AND SERVICE OFFICES

BOSTON—H. G. Davis, Inc.—Kenmore 5176
BRIDGEPORT—H. G. Davis, Inc.—Bridgeport 5-8160
CHICAGO—Lincoln Engineering Co. of Ill.—Calumet 5-6022
CLEVELAND—Lincoln Lubricating Systems, Inc.—Express 4334
DETROIT—Lincoln Engineering Co.—Madison 3484
EAST ORANGE—Lincoln Lubricating Systems, Inc.—Orange 3-3188
FORT WORTH—Fritz Keller—7-7211
LOS ANGELES—Lincoln Engineering Co. of Calif.—Richmond 0151
MILWAUKEE—Lincoln Equipment Service—Division 1191
NEW YORK—Lincoln Lubricating Systems, Inc.—Trafalgar 7-7900
OAKLAND—Lincoln Engineering Co. of Cal.—Higate 6130
PHILADELPHIA—Lincoln Engineering Co.—Locust 4-3877
PITTSBURGH—Lincoln Engineering Co.—Montrose 1444
PORTLAND—Pioneer Equipment Co.—Lancaster 0488

● *APPLY THE RIGHT LUBRICANT* ● *IN THE RIGHT QUANTITY* ● *AT THE RIGHT TIME*

B49-12

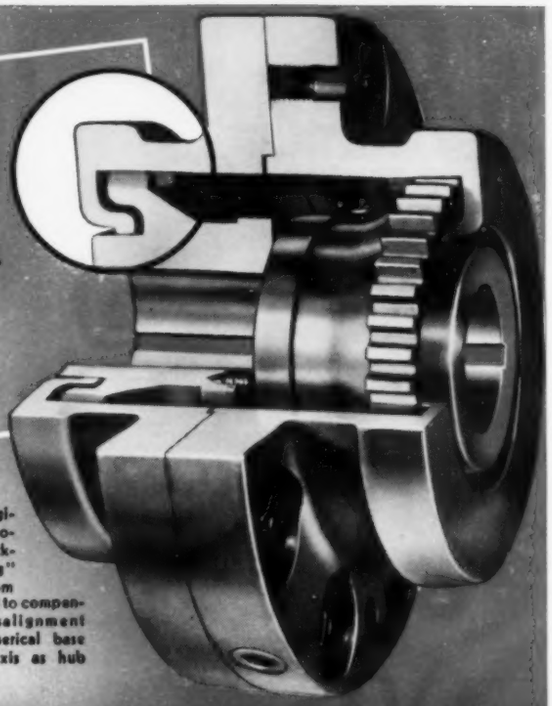
Bullneck Surface Check Grease Fitting ... the modern fitting with the ball in the top.

LINCOLN

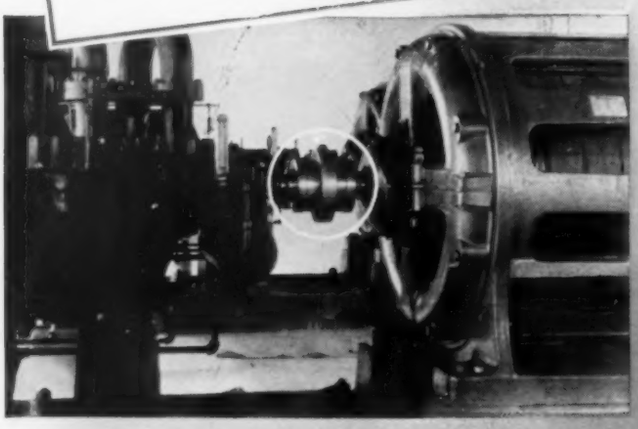
Builders of complete Lubrication Systems for a quarter of a century

LINCOLN ENGINEERING COMPANY • 5733 NATURAL BRIDGE AVE., ST. LOUIS 20, MO.

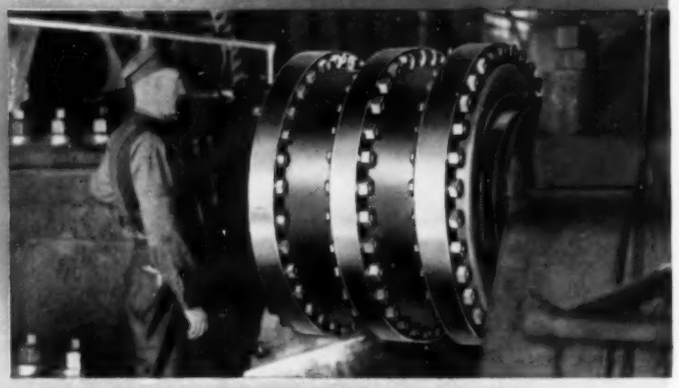
How Fast's Exclusive Metal to Metal Seal *Boosts* Your Plant's Production



Correctly engineered oil-protecting "rocking bearing" allows freedom of movement to compensate for misalignment because spherical base has same axis as hub spline faces!



OIL REFINERIES insist on Fast's Couplings to *keep* their vital machinery *running*, because they know Fast's virtually *eliminate* all shutdowns due to coupling failure! This Coupling has been in service since 1931.



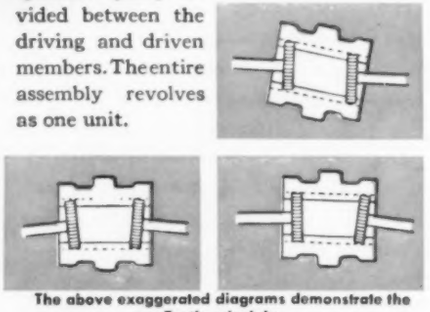
STEEL MILLS specify Fast's Couplings for equipment of every shaft size to avoid costly production shutdowns caused by failure of ordinary couplings! This Coupling has been in use since 1923!

YOUR production figures *go up* and *stay up* when your vital equipment is protected with Fast's Couplings, because Fast's virtually eliminate all shutdowns due to coupling failure. Fast's use no perishable parts or packing rings . . . they are the *original* gear-type coupling that *really* guards load-carrying oil from moisture, abrasive dust and grit! Fast's have *exclusive* "rocking bearing" principle that gives *sure* metal-to-metal seal.

When you specify Fast's you get years of top engineering experience, Koppers' high standard of workmanship, and unexcelled coupling service including available parts if required by change of drive, *even if your Fast's have been running for 30 years*. You save money, eliminate bottlenecks with Fast's on the job, because machine and motor life is prolonged, upkeep costs are cut, shutdown losses reduced. Find out about Fast's! Use the handy coupon, or write today for free catalog. Address: Koppers Co., Inc., Fast's Coupling Dept., 215 Scott Street, Baltimore 3, Maryland.

FAST'S COUPLINGS COMPENSATE FOR ALL MISALIGNMENT

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between the driving and driven members. The entire assembly revolves as one unit.



The above exaggerated diagrams demonstrate the Fast's principle.

KOPPERS

FAST'S *Self Aligning* **COUPLINGS**

MAIL COUPON FOR FREE CATALOG!

KOPPERS CO., INC., FAST'S COUPLING DEPT.,
215 Scott Street, Baltimore 3, Md.

Please send me your new Fast's Coupling catalog which contains all the facts and specifications.

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

New EC&M Magnet CONTROLLER

Gives Top-notch Operation on Any Magnet

LATEST NEW FEATURES

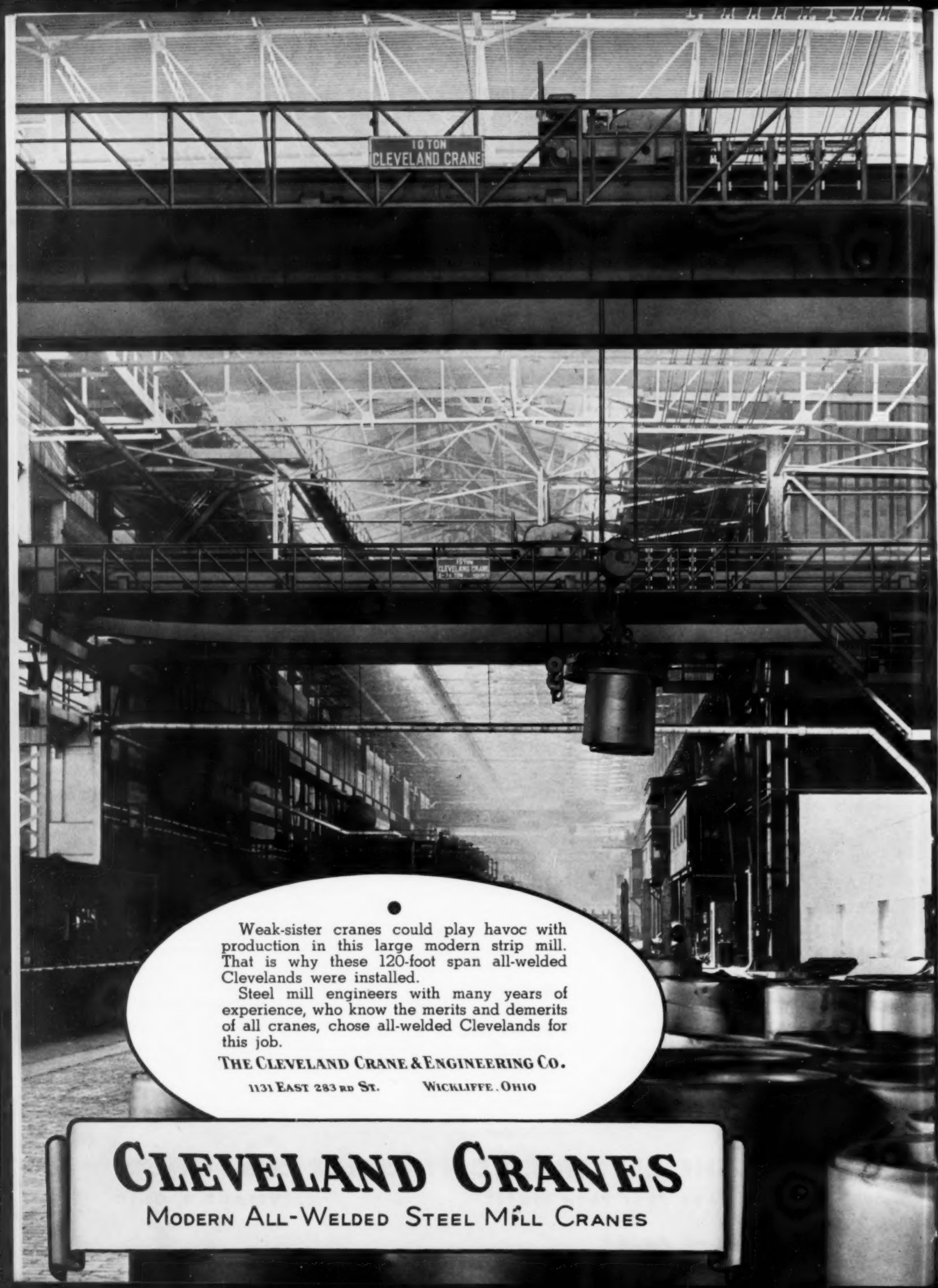
1. Adjusting-dial on outside of cabinet.
2. Fused control circuit.
3. Improved Contactors.

Look how easily the operator may adjust this controller. The adjusting-dial, conveniently located on the outside of the cabinet, permits easy adjustment to give a clean release of *every* load. Also important are the improved characteristics of the reverse-current contactor. It closes against an adjustable spring, factory-set so that this "drop" contactor opens accurately and quickly.

These EC&M *Automatic-Discharge* Magnet Controllers are suitable for use with *any* make of magnet. Bulletin 905 gives complete details. Write for your copy today.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO



Weak-sister cranes could play havoc with production in this large modern strip mill. That is why these 120-foot span all-welded Clevelands were installed.

Steel mill engineers with many years of experience, who know the merits and demerits of all cranes, chose all-welded Clevelands for this job.

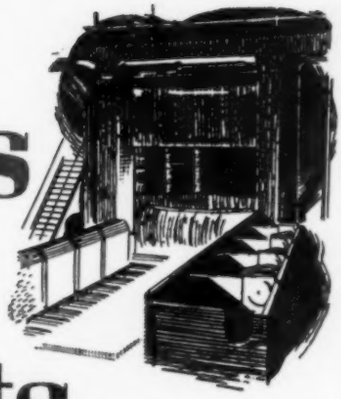
THE CLEVELAND CRANE & ENGINEERING CO.

1131 EAST 283 RD ST. WICKLIFFE, OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops *and* Shorts



THE AISE 1949 spring conference at Baltimore, May 2 and 3, was termed "the best ever" by many of those who attended. Attendance exceeded 900, with steel plant engineers and operators from every section of the country. Inspection trips to the Rustless division of Armco Steel Corporation and to Bethlehem's Sparrows Point plant attracted large crowds, and the managements of both plants deserve a rousing vote of thanks for their fine arrangements. Even the Lord Baltimore Hotel, headquarters for the meeting, did its bit by ending up the conference in a near blaze of glory, attended by most of Baltimore's fire equipment. We knew it was a good meeting, but we didn't think it was that hot!

▲

IT must have been a disillusioned soul who, at the spring conference, was overheard to define an industrial engineer as a fellow who ruins other people's business because he has no business of his own to ruin.

▲

WITH March setting an all-time monthly record for steel production at 8,388,965 net tons, the first quarter of 1949 established an all-time quarterly record of 24,053,181 net tons. This production set up another all-time record with more than 90,000,000 tons of steel in 12 consecutive months (April 1, 1948 to March 31, 1949).

In the face of these production figures and of slackening demand for steel, Louis H. Bean, an economist in the U. S. Agriculture Department, still insists that steel output must be expanded 12-15 per cent in the next five years instead of the planned three per cent. Mr. Bean's estimate is based on the recent rate of consumption of 1300 lb of steel ingots per capita, which is 50 per cent higher than the 1939 figure.

▲

HEADLINES in a single issue of the Wall Street Journal were as follows:

"Colorado Fuel and Iron Cuts Steel Operations Due to Drop in Orders."

"Basic Steel Demand Still Tops Capacity, Say Wheeling Steel Officials."

"Demand for Steel Now Being Satisfied, Says Sykes of Inland Steel."

"Youngstown Sheet Sets March Output Record."

E. T. Weir has stated that the operating rate may drop to 75 per cent by year-end, while E. G. Grace is considerably more optimistic.

In spite of this apparent confusion, however, the industry seems pretty much in agreement that the production rate will drop. This prospect has put part of the industry into a mild case of jitters, since many producers estimate their break-even point at about that figure.

Not so many years ago, the most economical point of operation was in the neighborhood of 75 per cent, and we can't help thinking that, when that rate is reached, the characteristic ingenuity of the steel industry will turn it into a profitable one.

▲

IT is generally believed that steel users are consuming their inventories and holding off steel purchases, in the belief that prices may drop. Certainly, scrap prices point that way. Steel producers, however, cannot make the price cuts that would spur demand until they know what demands labor will make in forthcoming discussions. The United Steel Workers of America will ask for pensions, social benefits, and perhaps a wage hike. Although some steel producers say "no raise," and auto manufacturers are rumored ready to hold the line, it is useless to expect steel price reductions until labor costs are settled.

▲

OF course, we've always known that blast furnaces are usually considered as feminine because they are temperamental, but we didn't know that sailboats are referred to as "she" because they make their best showing in the wind.

▲

SPEAKING before the recent meeting of the International Acetylene Association in Pittsburgh, Karl E. Mundt, U. S. Senator from South Dakota, said that he has failed to find a school that has a course presenting "what's right with America." There are plenty of places where students and people in general can find out what's wrong with America — or at least, what somebody thinks is wrong. But we leave it to chance that the individual will learn what is good about our country, and we blindly hope that the latter will overbalance the often violent criticisms.

Over the past 20 or 30 years, the "de-bunking" habit has grown strong. It has become the smart, sophisticated thing to do. And perhaps, among mature people of reasonable intelligence, it is not particularly harmful. Certainly, we would be the last to deny anyone (or to forego, ourselves,) the privilege of griping about things. But it is perfectly reasonable that the impact of the continuous criticism of things American upon youngsters' minds might set up prejudices and beliefs that are unwarranted and false. Maybe the Senator has something. Maybe we should have courses in every school on "what's right with America."

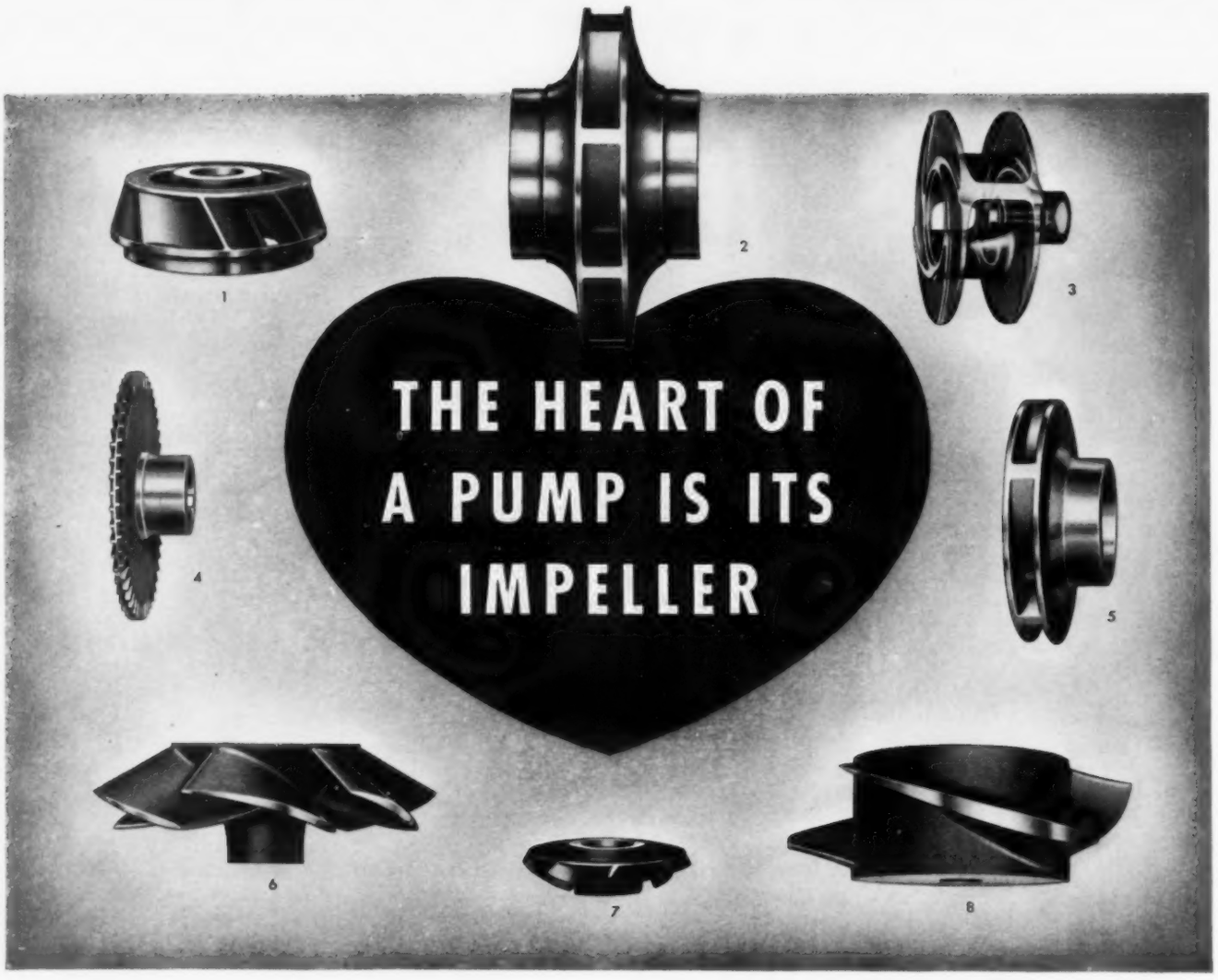
▲

STEEL industry sales for 1948 set an all time record. Companies representing 90 per cent of the total capacity report over $8,000,000,000 sales, and total net income of $542,000,000. This latter figure represents a profit of 6.7 cents per sales dollar, which is under the industry's average through the 1920's, and less than the 7.5 cent average reported for 1948 by other industries.

The 1948 profit represents a return of 10.9 per cent on invested capital and 14 per cent on net worth, which are less than corresponding returns for other types of industry.

▲

A SURE cure for anyone who inclines to communism and advocates common ownership of all property would be to put him on a telephone party line.



Peerless Pumps utilize many different impeller designs to meet various fluid conditions

What makes a pump "tick?" Its heart is an impeller!

Pictured above are eight Peerless impeller designs for varying fluid conditions. No. 1 forces water upward from deep wells. No. 2 is a double suction design for high capacity horizontal pumps. No. 3 pumps solids in suspension. No. 4 handles all liquids in small capacities, at high heads. No. 5 is of single suction design for process services. No. 6 combines both radial and axial flow. No. 7 is a semi-open impeller for small diameter deep wells. No. 8 is an impeller that "propels" large liquid volumes.

The point is—capacities, lifts, heads, temperatures, chemical analysis, clarity, shaft speeds are seldom common to different pump services and installations. Because fluid conditions vary, Peerless pump designers are versatile and Peerless pumps utilize this versatility in different impellers for varying fluid conditions, successfully pumping most liquids in all industries.

Peerless horizontal pumps are available for general purpose pumping, for handling sewage and other materials in suspension, for most all process services, for moving chemicals and oils, for acids and caustics and for such specialized applications as l-p gases.

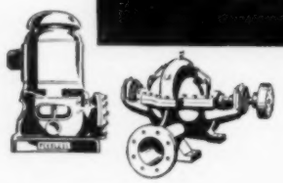
Peerless vertical turbine pumps are available for lifting water from deep wells or close-coupled for wet or dry pit installation and for drainage, drydock, canal diversion and flood control services.

Plan with Peerless for all your needs for pumps. Individual descriptive Bulletins on each of the types of Peerless Pumps described above are available upon request.

Peerless
VERTICAL AND HORIZONTAL
Pumps

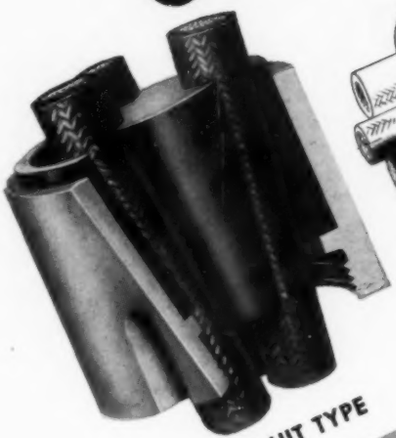
fmc
PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Los Angeles 31, California Indianapolis, Indiana
District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 N. Broadway; *Atlanta Office:* Rutland Building, Decatur, Georgia; Omaha, Nebraska, 4330 Leavenworth Street; Dallas 1, Texas; Fresno, California; Los Angeles 31, California

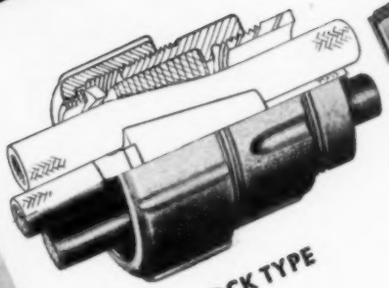


3 WAYS TO MAKE SURE CABLES STAY PUT!

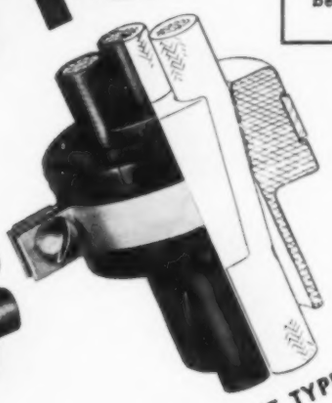
National Electrical Code paragraph 3014 specifies intervals at which cable supports must be used in vertical raceways.



CONDUIT TYPE



LOCK TYPE



SPLIT TYPE

When you're looking for a better way to hold cables fast, protect connections against pull or vibration—install O. Z. Cable Supports.

WHY?

BECAUSE O. Z. makes the *only* cable supports with one-piece impregnated maple plugs, machined to the exact wire size.

BECAUSE there is an O. Z. support for installation before or after pulling wire.

BECAUSE the serrated O. Z. liner provides a *positive* grip when plug is wedged home.

BECAUSE you can choose from three basic types the *best* support for your job—

1. **CONDUIT TYPE** for fast, easy installation on vertical runs. Screws directly on conduit. Malleable iron body grooved for tightening with screwdriver.
2. **LOCK TYPE** for use in *any* position. Threaded collar pressing against plug assures vibration-proof support under all conditions.
3. **SPLIT TYPE** for quick changeover jobs where cable is already installed. Body halves placed around cable, steel band fastened, and assembly placed on top of conduit.

There are thousands of O. Z. products designed to help you put power where you want it, and your O. Z. distributor is the man to see about them. Send for illustrated catalog.

5305

And Remember—They're O. K. If They're O. Z.

CONDUIT FITTINGS • CABLE TERMINATORS • CAST IRON BOXES
GROUNDING DEVICES • SOLDERLESS CONNECTORS • POWER CONNECTORS

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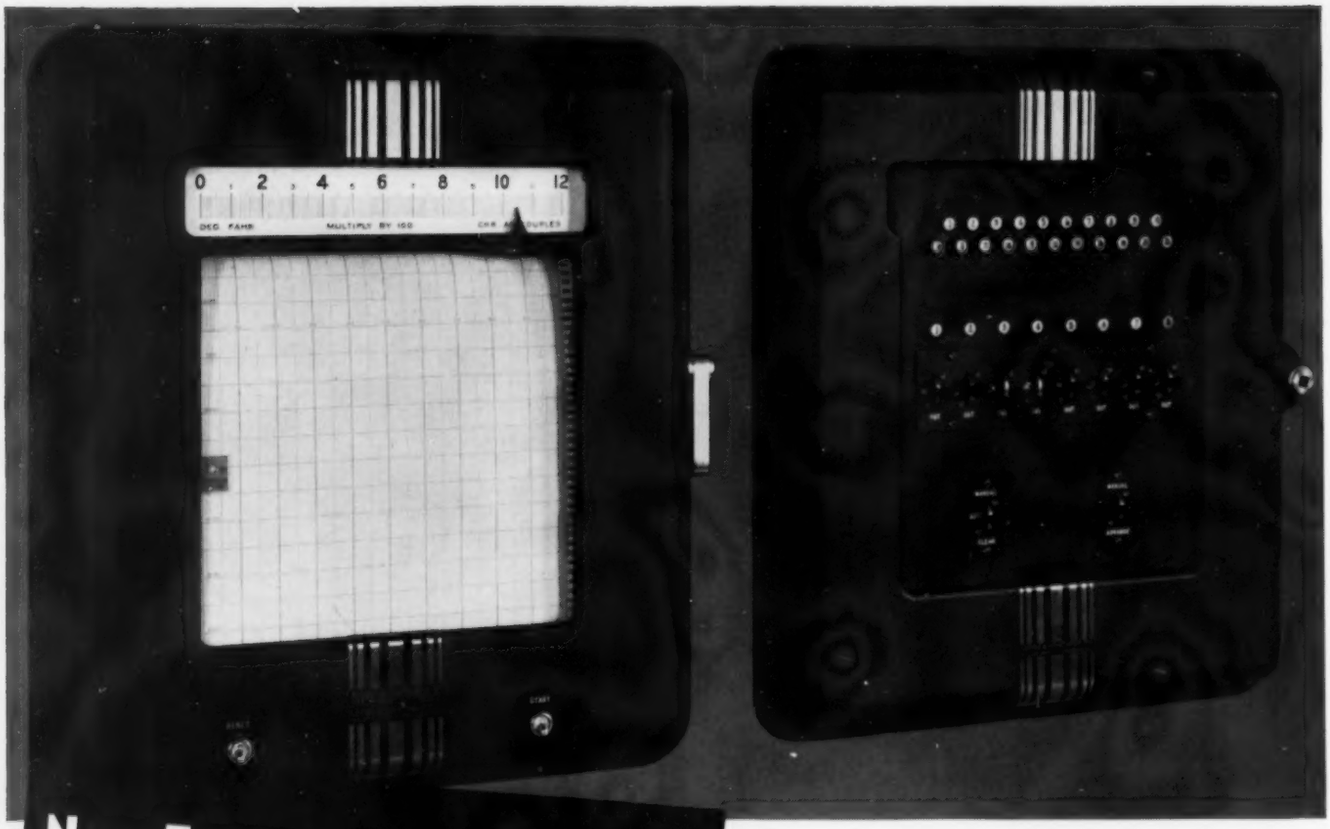

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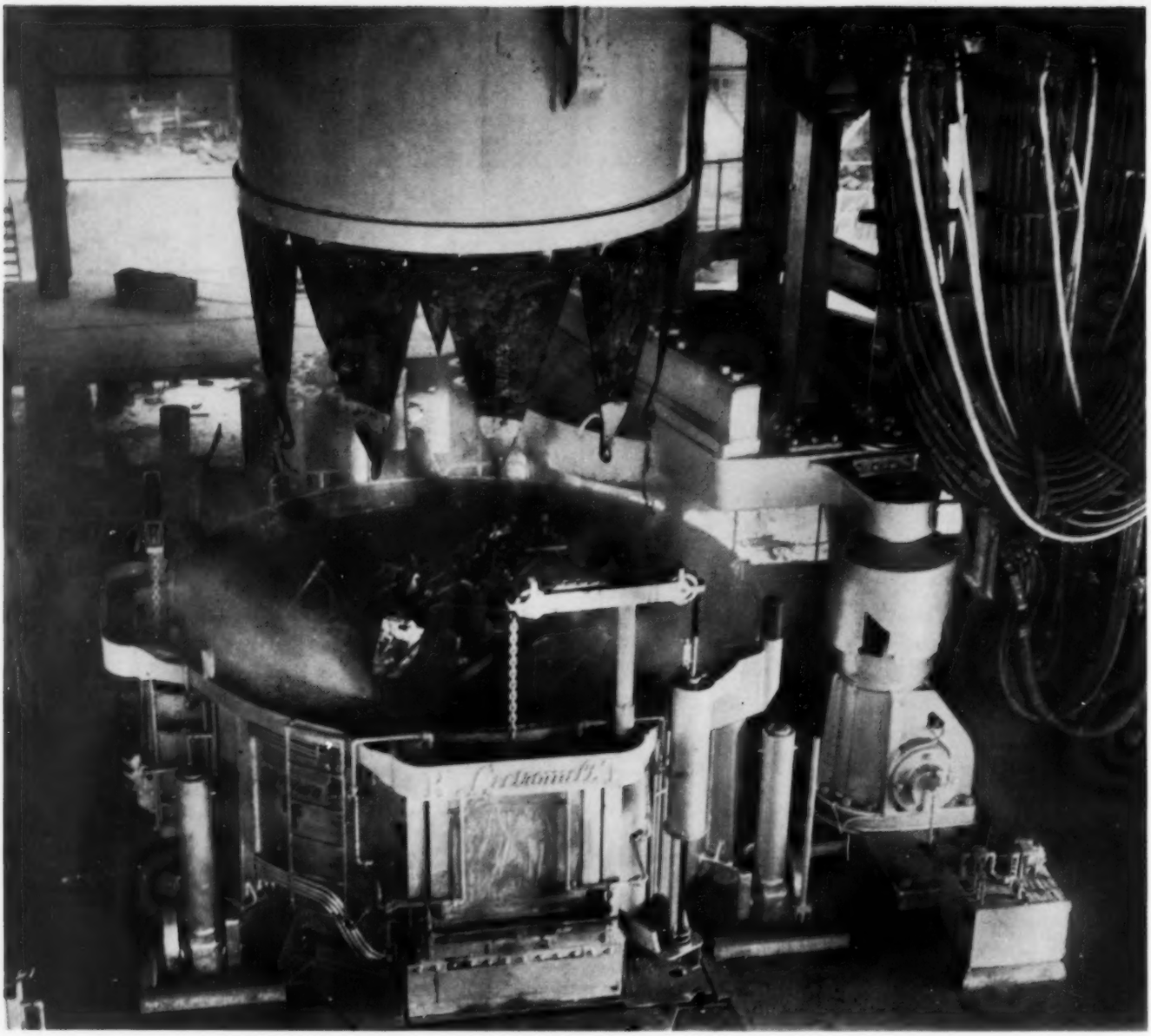

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MACHINE SCARFING OF STEEL

. . . . machine scarfing is particularly applicable to those steels which have light surface defects . . . . such steel can be made suitable for final rolling without further conditioning . . . .

By O. K. SHARP
Superintendent, Blooming and Billet Mills
Republic Steel Corp.
Buffalo, N. Y.

▲ THE first question that arises in the minds of a great many probably is: "What is machine scarfing and why is it necesary?"

Machine scarfing, also known as desurfacing or flame scarfing, is the removal of surface defects, from a slab, bloom or billet, by means of multiple oxygen—acetylene torches, during some stage of the rolling operation, while the slab, bloom or billet is still at a rollable temperature. The chief reasons for machine scarfing are to obtain a steady flow of materials, in order to maintain proper schedules through the various rolling mills and in some cases to produce a better billet for direct trade shipments.

Perhaps, at this time, a brief resume of surface conditioning problems encountered in steel mills in the past years might be in order. When customers' requirements for surface became such, that steel rolled direct from an ingot, or reheated in a subsequent rolling operation, no longer was satisfactory, some means of removing surface defects before rolling into finished size or before shipment had to be devised.

The first production methods were chipping by means of a pneumatic hammer and hand or swing grinding. Both of these methods involved an additional handling of materials, many men, and were slow laborious work. Several types of chipping machines and milling machines were devised, but none of these ever proved very popular. With the increase of extruding machines, upset forging machines, forging presses, cold heading machines, flashless nut machines, cold forming machines and the like in the customer's plant, surface requirements became even more stringent. This meant an increase in the amount of billet conditioning necessary and the operation rapidly became a bottleneck, because of the number of men required and also because of lack of facilities to economically handle such large forces. As has been true in all cases in American industry, necessity became the mother of invention, and hand scarfing was introduced.

This was the removal of defects, generally from cold material, by means of a hand oxy-acetylene torch similar to a cutting torch, and this speeded up the conditioning operation considerably. This method did not become practical, however, until the introduction of the starting rod, which reduced the preheat time to almost zero. While hand scarfing speeded up the conditioning operation, it however also had the drawbacks of an additional handling of material, was a hot job performed under unpleasant conditions, and could be used only on certain grades of steel. Other grades of steel, with air-hardening properties, had to be preheated before scarfing to prevent cracking. This made the job more unpleasant.

One of the drawbacks, of all methods of conditioning in use up to this time, was that there was no means of removing defects from blooms, which were rolled direct from ingots to billets or skelp, on a continuous mill, without reheating. This meant that, in some cases, the blooms were rolled to an intermediate size, allowed to grow cold, then conditioned, reheated, and rolled on another mill.

The foregoing objections and drawbacks, brought into being the scarfing machine.

The first question that rises with the selection of a scarfing machine is the size of material to be scarfed and whether all sides, or only certain sides, are to be scarfed. If the blooms to be scarfed are in the size ranges from 5 x 5 to 10 x 10 in. a smaller machine is needed than if size ranges are 10 x 10 to 16 x 16 in., or if slabs are to be scarfed. By the same token, if only edges of slabs or skelp are to be scarfed, a different type of machine would be required.

The next step is where in the roller line should the machine be installed. It is perhaps unfortunate that in most blooming mills of today there is not too much choice, on the location of the machine, and it is located where it will not cause interference with the blooming mill roll stand thereby causing rolling delays. The ideal location would be one where the material being scarfed is entirely free of the blooming mill reversing table, the shears, or the billet mill, and would have space available nearby for the operator's pulpit, maintenance room and the necessary auxiliaries.

In our own particular case, on certain sizes, the desurfacer operator has to time his start with the position of the next ingot in the rolls, because the back end is still on the reversing table, and in all cases the bloom is through the shears when scarfing is completed and must be backed up to take a crop, thereby putting a greater burden on the tables.

The installation of a scarfing machine necessitates a considerable amount of auxiliary equipment. Adjust-

Presented before AISE Buffalo District Section Meeting, January 13, 1948

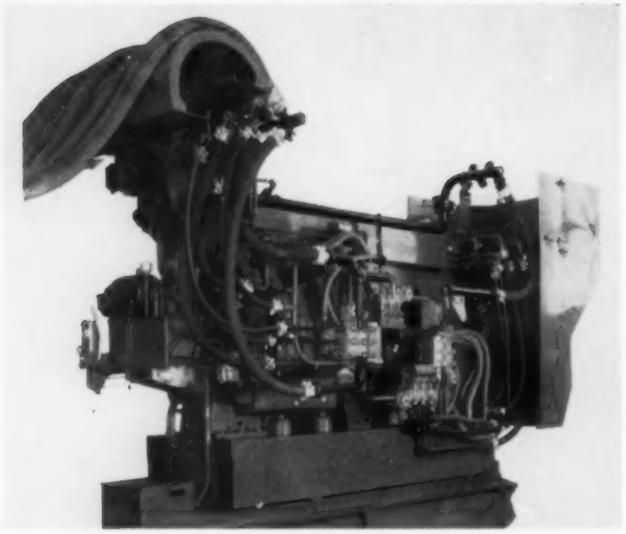


Figure 1 — This machine scarfs four sides of the bloom simultaneously, moves in and out of the roller line as desired, and has a size range of 2-½ to 10-¾ in. square.

able speed motors for the entry and delivery tables are necessary, so that proper scarfing speeds can be maintained and so that depth of cut can be varied. A high pressure pump to furnish water at a pressure of 125 psi for granulation of the scarfing cinder must be installed, and also a low pressure pump of 150 gpm capacity, to provide circulating coolant water to cool the scarfing heads. An exhaust fan, hood and stack are necessary for fume removal. An adequate system of removing the scarfing cinder is very essential, and the pit should be properly located so that it can be periodically cleaned. Provision must also be made for an adequate supply of compressed air, oxygen and acetylene. In our department, this meant the installation of an acetylene generating system. Last but by no means least, a suitable maintenance room should be built so that spare units can be repaired and regular minor repairs effected. Wherever necessary with these auxiliaries, the proper electrical control equipment must be installed to assure satisfactory operation.

The scarfing machine proper is mounted on a carriage at right angles to the roller line and is moved in or out of the roller line as occasion demands. The part of the machine which actually performs the scarfing operation consists of four units or scarfing heads. Each head is independent of the others and when in place in the machine form two L-shaped units, which during scarfing, by means of air and hydraulic cylinders, close into position around the bloom forming the proper size square or rectangle. Size changes are made by varying the length of the vertical leg of the L and by varying the distance the heads close horizontally.

Each scarfing head is made of copper into which a number of nozzles have been inserted at an acute angle to the piece to be scarfed. The surface of the head and the nozzles are protected from abrasion by alloy wear strips, and cooling water is circulated through the head to prevent extreme temperature. Each nozzle has an individual acetylene and oxygen connection to a common manifold in the head, and can be shut off individually for size changes. For our purpose we use one nozzle for each inch of the perimeter of the piece to be scarfed.

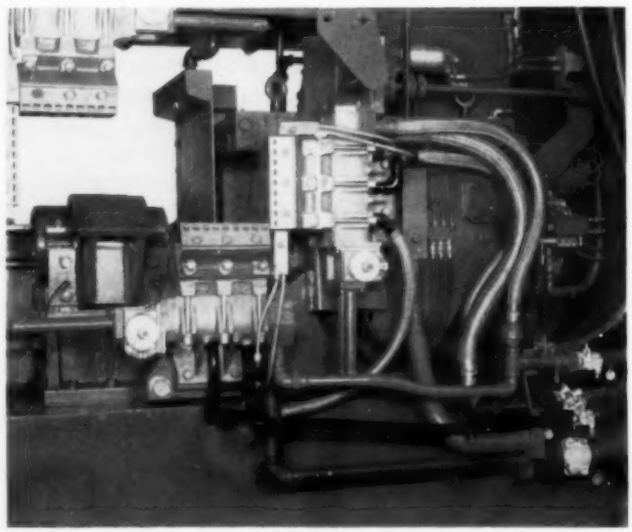
In order to scarf, the operator must first run the machine into the roller-line, start his high pressure water pump, exhaust fan, and open main line regulators on both oxygen and acetylene lines. All of the controls necessary to start operating are in his pulpit or immediately adjacent. He then purges the lines and makes sure the machine is functioning properly.

For the actual scarfing, the operator positions the piece to be scarfed in the machine attempting to make the start as close to the end as possible to reduce scrap loss. When the piece is positioned, he places the scarfing controller in the ON position. This causes the heads to close about the piece, the preheat oxygen and acetylene are ignited by the heat of the bloom, and the timing cycle of the machine is set in operation. After a timed preheating period, which can be regulated and in our case is 5-8 seconds, the high pressure cutting oxygen, high pressure slag water come on automatically, the tables start to move the piece forward, and scarfing or desurfacing takes place. To stop the operation, the operator returns the controller to the OFF position, the oxygen and high pressure water are shut off, and the heads retract. In our set-up, as a safety feature to prevent damage to the scarfing heads from hot-top fins, we have a pinch roll set ahead of the machine which rides the piece being scarfed. When the end of the piece passes through the pinch roll, the roll drops and the scarfing operation is stopped automatically.

During the operation, the operator checks to see that:

1. His preheat is of proper time and that he is starting at the correct place.
2. That all nozzles are cutting properly.
3. That his water nozzles are open and properly adjusted so that cinder is properly granulated and washed into pit.
4. That his various oxygen, acetylene, water pressures and table speeds are correct.

Figure 2 — A closeup of Figure 1, showing head and nozzle detail, piping and hose connections.



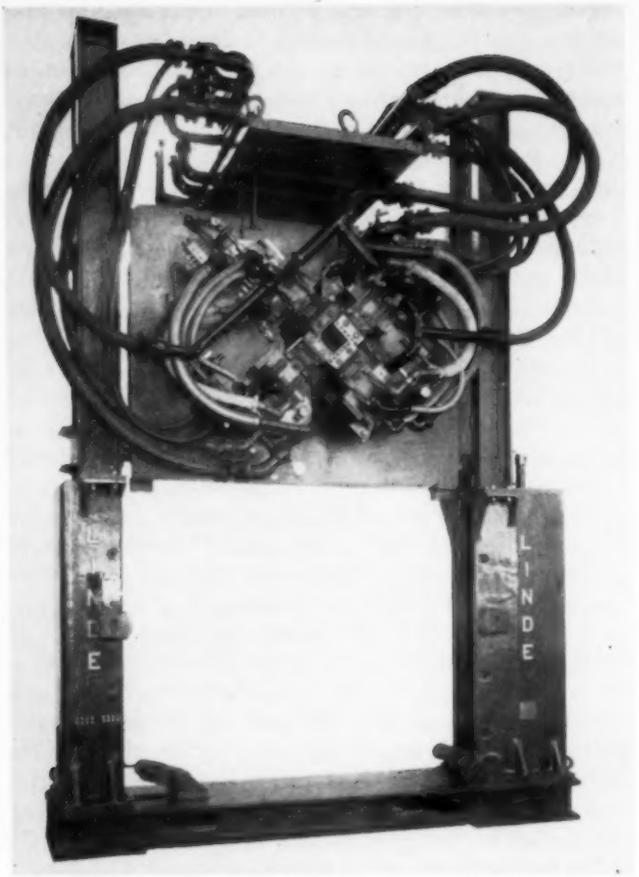


Figure 3 — It is possible to scarf four sides, on the diamond, varying from 2-¼ to 7-⅛ in. square on this machine which is limited to squares only. It is moved in and out of line by means of an overhead crane.

5. That the tables are running properly so that the piece moves evenly and steadily through the machine.

It might be well to repeat that once the piece is in position, it is necessary for the operator to use only one controller.

Some of the operating data connected with our machine is as follows: Oxygen main line pressure is 200 psi, preheat oxygen is 0.5 psi, and cutting oxygen varies from 35 to 45 psi, depending on depth of cut desired. Acetylene is carried at a pressure of 5 psi. Table speeds which for normal operations are 300 fpm, will vary from 115-185 fpm for various depths of scarfing. Our time of scarfing varies from 25-50 seconds with different sizes. Added to that is some slight additional time for positioning.

Along with the safety feature of the pinch roll ahead of the machine, our tables and machine carriage are so interlocked that the tables cannot be operated when the machine is being run in or out of line. Also when the scarfing machine is in operation, the machine operator has full control of the tables and the table operator does not regain control of the tables until the scarfing operation is completed. In the event something should go wrong during the actual scarfing, there is a push button emergency control directly in front of the operator which stops all operation of the machine.

The most important things necessary to keep the scarfing machine in operation are:

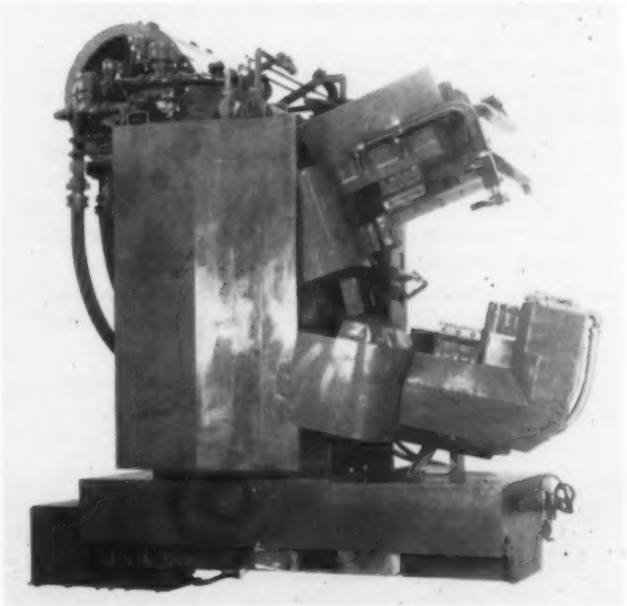
1. Keeping the cinder properly granulated and washed into a settling pit so that it does not ball up around the heads or table rolls, and removing this material regularly from the pit so it will not get into sewers.
2. Keeping the exhaust fans and connecting ducts clean and in good operating condition so the fumes do not become objectionable.
3. Proper maintenance of scarfing heads, tubing and connecting hoses so that blow backs do not occur.

Our maintenance set-up is such that one of the four units are changed each week whether it is necessary or not. The unit removed from service is partially dismantled by the repairman, nozzles cleaned or replaced, tubing and head checked for leaks and steamed out, and all water piping checked. He then reassembles the unit and prepares it for service. In this manner, a spare unit for each position is kept ready to go into the machine at all times and additional heads are always on hand if needed.

The repairman also checks to see that the machine is properly lubricated, that the retracting cylinders are operating properly, checks oxygen and acetylene regulators, pumps, water valves and pinch rolls operations. He is fully responsible for the operation of the machine and is subject to call at all times, and the selection of the proper type of man for this position is vitally important for the successful operation of the desurfacer.

Our chief difficulties to date have been mainly with auxiliary equipment or careless operation of the machine. We have had trouble finding the proper type of quick opening valve for the high pressure water, that is one which will shut off completely and still remain in service for a reasonable length of time. Another difficulty has been in erosion of the exhaust fan due to particles of cinder being carried over. Blow backs and mechanical difficulties of the machine itself have been at a minimum.

Figure 4 — This machine scarfs four sides of the bloom simultaneously, moves in and out of roller line, and has a capacity of 2-½ in. square to 7-⅛ in. by 10-¾ in.



In conclusion, a few words about the types of steel scarfed, general practices and the results of scarfing, might be in order. It has been our experience that machine scarfing is successful principally on those grades of steel which inherently have only light surface defects. These take in the higher carbon ranges, from about 0.40 per cent carbon on up to file grades and higher carbon alloys, spring steels being especially adaptable for machine scarfing. By selection of grades to be scarfed, we have been successful in producing a high percentage of machine scarfed steel which is suitable for rolling into a finished product with no further conditioning. Low carbon grades of steel are machine scarfed only when special requirement surface quality must be met.

It must be borne in mind, however, that the scarfing machine is no cure-all for surface problems. To obtain good results from the scarfing machine, the commonly accepted good open hearth practices, good heating in the soaking pits, and proper rolling technique, must be carried out.

DISCUSSION

PRESENTED BY

E. W. WILLARD, Assistant Superintendent, No. 7 Mill, Bethlehem Steel Co., Lackawanna, N. Y.

O. K. SHARP, Superintendent, Blooming and Billet Mills, Republic Steel Corp., Buffalo, N. Y.

J. H. JANSSEN, Ass't. Chief Metallurgist, Wickwire-Spencer Steel Division, Colorado Fuel and Iron Corp., Buffalo, N. Y.

W. A. THOMAS, Superintendent of Processing Departments, Atlas Steels, Ltd., Welland, Ontario, Canada

H. J. CUTLER, Engineer of Tests, Bethlehem Steel Co., Lackawanna, N. Y.

J. D. DICKERSON, Chief Metallurgist, Republic Steel Corp., Donner Plant, Buffalo, N. Y.

F. A. SPARK, Atlas Steels, Ltd., Welland, Ontario, Canada

J. F. BLACK, General Superintendent, Wickwire Spencer Steel Div., Colorado Fuel and Iron Corp., Buffalo, N. Y.

J. L. EDWARDS, Superintendent Finishing Mills, Republic Steel Corp., Donner Plant, Buffalo, N. Y.

WALTER RADLEY, Assistant Combustion Engineer, Republic Steel Corp., Buffalo, N. Y.

G. KEMPF, Mechanical Foreman, Bloom and Billet Mills, The Steel Co. of Canada, Hamilton, Ontario, Canada

W. W. JACOBS, Metallurgist, Atlas Steels, Ltd., Welland, Ontario, Canada

E. W. Willard: Mr. Sharp and I operate the same kind of machine and condition the same kind of material.

For the different grades of steel in the finishing mill we feel the machine furnishes a long-felt need. Mr. Sharp said that years ago the principal conditioning was through chipping or grinding, and I know myself when we get a bad heat in the yard, it is often the habit to throw away the real bad ones, as we felt it was cheaper to throw them away than it was to condition them. Since we have the scarfer, we find that these rejections have been pretty well cut down, in fact they might be eliminated.

We have been experimenting quite a bit on pressures and speeds to get a good even surface, and I would like to ask at this time what your experience has proven on high sulphur steel on pressure, the speed of the table, and anything else that might interest us and also your experience on silica steels that have scabby butts occasionally.

O. K. Sharp: First of all, we normally do not scarf high sulphur steel. High sulphur steel breaks up generally to such an extent that even after machine scarfing, considerable hand conditioning is necessary, and once you get in the hand conditioning department you have a handling charge no matter how little or how much scarfing you do. We find it costs us money, removing much good material and still leaving a crack which is deep. There are only one or two applications and that is usually a cost proposition. As for silicon steels, there is no problem with good ingot to billet practices. The vast majority of silicon steels go directly to the bar mills with no further conditioning.

J. H. Janssen: I would like to know if the speaker has had any experience with the scarfing of rimmed steels, and also who and what determines the length or depth of the cut you are going to take?

O. K. Sharp: As far as scarfing rimmed steel is concerned, that is perhaps less than half of 1 per cent of the production on our scarfing machine, and that is only for one application which is very special. If the open hearth produces good rimmed ingots, and the right thing is done in the soaking pits you get a good result. If you ruin it, the scarfing machine will not correct it.

When we installed the machine, we experimented for quite a considerable period of time and we arrived on what we call average depth cut and normally use that. We do have a man who works in the metallurgical department who has a record of each heat in the open hearth. He has the charging time and soaking time, and observes it as it goes into the mills, and he tells our operator what to do—whether or not it should be scarfed, whether we should take a normal cut, or whether we should take an extra heavy cut.

William A. Thomas: Will you tell me what depth of cut you take with your machine?

O. K. Sharp: It is a light $\frac{1}{32}$ in. per side, and when we have something special we take $\frac{1}{16}$ in.

H. J. Cutler: We have at Lackawanna a machine which is similar and our use of the machine is likewise similar. When we considered a scarfing machine, we had the same object in view. Frequently, an ingot is not perfect and the blooms or billets that will be produced from it may have, to some degree, the imperfections that were in the ingot. The scarfing machine offers the opportunity of improving the surface quality.

From the point of view of what we would put through the scarfing machine, we had in mind three classes of material; first, material where requirements were unusually severe, such as cold heading stock, automotive axles, seamless tubing, etc.; secondly, orders where possibly in the future greater emphasis will be put on decarburization and seam depth. We felt the scarfing machine would help considerably in meeting those two requirements. Thirdly, there are grades of steel which generally give more trouble with seams. There would be included here the occasional heat that receives poorer than standard practice. As Mr. Sharp said, "If the practice is good all along the line, then you do not need a scarfing machine." However, every once in a while, the open hearth does not do the maximum job in preparation of molds, or experiences bad pouring conditions. The blooms from such heats can be helped considerably by the scarfing machine. With these three principal uses in mind, the scarfing machine seems to be worthwhile and the short length of time our machine has been in operation has been sufficient to indicate that the judgment was correct.

It might be interesting historically to tell about a machine called the "deseamer" that the Lackawanna Steel Co. installed more than 30 years ago at their rail mill. As you all know, the surface of the head and base of a rail is most important and is given close inspection to insure freedom from seams. Rail steel chemistry is approximately 0.65/0.80 carbon, 0.60/0.90 manganese, 0.10/0.23 silicon. The Lackawanna Steel Co.'s rail mill rolled 127 lb rail from an ingot 19 x 19 in. There were 15 passes from the ingot to the finished rail so you mill men can see what heavy initial drafts had to be taken. The first two passes were really hogging passes, each with over 5 in. reduction.

Mr. Mathias, vice president of the Lackawanna Steel Co., designed the deseamer. It was a rotary milling machine, having two large drums with teeth cut on them. They rotated at high speed and were set at a height to take the desired cut. The shape entering the deseamer was a little convex, top and bottom, and this metal was removed by the milling machine. It did a wonderful job and produced rails, the head and base of which were free of seams.

For a number of years, blooms for forging quality billets were put through the deseamer. This produced billets with two sides that had been deseamed. We frequently wished it were possible to bring the bloom back to the entry side of the deseamer, turn it 90 degrees, and put it through again; thus deseaming all four sides.

It was thought that this deseaming machine might be of interest since it was installed over 30 years ago, at which time there was interest in removal of light surface defects from rails.

J. D. Dickerson: I think Mr. Cutler touched on something that could be enlarged on for a moment, and that is the elimination of pickling by the use of the scarfing machine. We have found to some extent, at least on certain grades of steel, pickling may be eliminated in the semi-finished condition by the preliminary scarfing of the billet. I still want to emphasize, however, that the scarfing machine is not going to be a panacea for scarfing, open hearth practice or blooming mill practice prior to rolling. Anything with deep defects is going to have to be hand scarfed. Where we use a scarfing machine in such an application as piston pin stock, you have to do practically 100 per cent skinning operation at considerable depth in order to get that product into usable condition.

F. A. Spark: Could the scarfer be adjusted to scarf the corners as well as the flat?

O. K. Sharp: The scarfing machine does take care of the corners.

F. A. Spark: As well as the flat?

O. K. Sharp: Yes, we produce different types of products off of it and all defects are not on the flat of the surface, there would be some defects on the corner. The nozzles are such that each nozzle covers an inch of perimeter and they wash right over, so once the piece has gone through the scarfer it has been scarfed all around including the corner.

William A. Thomas: In removing of surface, if the seams are deeper than cut made would the scarfer tend to cover them up?

O. K. Sharp: No, we scarf direct and finished blooms, some of which continue on and go through our billet mill and are rolled into smaller sizes, and also sizes taken off immediately after scarfing and allowed to go cold which are for the larger bar mill. It is my opinion rather than covering up, I believe desurfacing helps it. It forms a new scale, and while the scale is rather tight, it gives you a finely glazed surface and the defects stand out better.

J. F. Black: I think we are all curious about your percentage of loss in the average cut; also what latitude, if any, do you give your operator to change pressure or speed according to the steel surfaces going through the machine? Do you have any conditioning after scarfing? Are the shallows which develop during scarfing of any consequence so far as further rolling is concerned?

O. K. Sharp: The percentage of loss varies on size of your bloom. We figure for our own purposes we lose from one to two per cent depending on size. The smaller size has the greater loss, and the larger sizes the smaller loss. Our larger size is seven by seven. If you are going to scarf ten by ten your loss will be reduced considerably.

As for the latitude given the operator, scarfing is only done on what he is instructed to scarf. He is instructed to scarf by the inspector who follows the heats in connection with the metallurgical observer. He gets a record of the open hearth. He tells the operator what to scarf and we have very few exceptions to that rule.

The third question I think was just raised before; after machine scarfing, as far as we can find out, and as far as anybody I know has ever determined, there is no effect on the surface that would tend to hide any defects that are there. Defects appear a little bit more clearly than they were before.

J. L. Edwards: Before we had the machine scarfer, we were forced to pickle more of our steel before it was chipped or hand scarfed; and billets or blooms which have been pickled have more of a tendency to stick or weld together in our reheating furnaces.

This condition is not so likely to occur with unpickled, machine scarfed materials, and our heaters are

enabled to produce a dry and loose scale which is easily removed with our 1000 psi hydraulic sprays.

When it is necessary to hand scarf deep breaks or ingot cracks, we get into trouble due to folding in of deep hand scarf marks when it is required to pull two or more heavy drafts before the bar is turned up.

Walter Radley: You might be interested in the method of measuring this process. At the time of installation there was only one company that would agree to furnish an instrument measuring the oxygen. The set up consists of an orifice plate in the line; two impulse lines connected to a pneumatic transmitter, then to an electrical transmitter with two wires leading to the recording instrument. In looking at a 24-hour chart with each ingot taking only a few seconds to pass through the machine, the pen makes a straight line up and down from the zero point. You can actually count the number of ingots in a 24-hour period. It is my understanding that another company has an instrument on the market for measuring driox.

G. Kempf: After you are all finished, how does the old method of hand scarfing and chipping compare with the cost of automatic scarfing?

O. K. Sharp: I cannot quote figures, but by selecting grades, by selecting heats, so that we will get an end product which is going to be satisfactory, we figure we are a little bit ahead on the cost side. There are certain grades on which we know we are losing money if we machine scarf. There are certain grades on which we feel we are saving money. In the over-all picture we breaking even and maybe a little bit on the plus side. While the loss of yield in machine scarfing is so great, your loss in hand scarfing is considerable.

W. W. Jacobs: Someone passed the remark that machine scarfing would tend to preclude the necessity for pickling. We have found that on certain types of steel, for example a 0.60 per cent carbon, 0.20 per cent molybdenum steel, even after machine scarfing, it is necessary to pickle to show up the seams.

The question I would like to ask is this: Based on your past experience, do you think it is possible to roll direct from ingot to finished bar and do away with any necessity of hand conditioning in an intermediate stage considering an ingot of average size?

O. K. Sharp: Today that is being done in our new Chicago plant where they have 32-in. bar mill and thirty types of products are rolled direct.

W. W. Jacobs: What type steel and what type of product?

O. K. Sharp: That I am not familiar with, but it would be my guess it must be higher carbon ranges.

W. W. Jacobs: Are they machinery steels?

O. K. Sharp: I do not believe so. I do know they are shipping some percentage of their product direct to the customer off the 32-in. bar mill which was heated once as an ingot.

FACTORS AFFECTING SURFACE QUALITY*

By L. R. WALKER

Edgar Thomson Works

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▲ THIS paper is a discussion of some of the problems encountered at one steel-making plant in producing semi-finished and finished material to acceptable standards of surface and internal quality.

One such problem is the improvement of the surface of low-carbon killed deep-drawing steel slabs. The presence of cracks on the rolled surface of the slabs was the major source of rejection, and this cracking contributed substantially to increased conditioning costs and, to a lesser degree, to rejections of finished sheets. Increasing the control temperature of the soaking pits used in heating the ingots by 35 F and increased soaking time was productive of crack-free slabs, with pipe and blister rejections for the finished sheet at an acceptable level.

The presence of scabs and slivers on the slabs, while not a major source of slab rejections, was a principal cause of high conditioning costs. It was decided to experiment with faster teeming rates, the theory being that the metal in rising at a greater rate would dissolve most of the solidified splashed metal adhering to the side of the mold. The standard nozzle size in use was 2 inches. After preliminary tests, a 3-in. nozzle was tried on a series of 20 heats, making certain to obtain a fast initial teeming as compared to teeming with a cushion using the 2-in. nozzle. A close comparison of conditioning costs was encouraging, costs being decreased by 50 per cent. Since there were advantages to the open hearth, with few disadvantages, the 3-in. nozzle was adopted as standard, and conditioning required has been maintained at a new low level. Sliver rejections on sheets also decreased substantially, while pipe and blister performance was not adversely affected.

While the pipe and blister performance was normal and acceptable by past standards, it was still higher than desirable. While several factors were brought to light by investigation, by far the most important was that pipe and blister occurrence was confined almost entirely to two larger of three mold sizes. Since the holding time at the pouring platform was the same, 1 hour, for all three sizes, the logical conclusion was that an increased holding time should be beneficial to ingots in the two larger molds. A trial run of heats was made with the holding time increased 50 per cent for the two large molds. Results were gratifying, as pipe and blister were greatly reduced. Rejections due to these causes were lowered to such an extent that the economy of a longer holding time was beyond question.

*Condensation of a paper presented at the Quality Session of the National Open Hearth Steel Committee meeting sponsored by the American Institute of Mining and Metallurgical Engineers in Chicago, Ill., April 20, 1949.

SPECIAL CARS FOR STEEL PLANTS

. . . . many of the economies in steel plant operation can be attributed to the development of materials handling equipment for handling the raw and finished materials . . . .

By E. W. SCHELLENTRAGER
President
The Atlas Car & Mfg. Co.
Cleveland, Ohio

▲ MANY types of special cars are used in steel plants. It is the purpose of this paper to mention some recent developments of those types.

Scale cars—Of the various types of special cars used in steel plants, the blast furnace stockhouse scale cars are probably the most important, because most of the materials charged into the blast furnace are handled by these cars, and the quality of the iron produced depends upon their accurate weighing performance. On this account, over the years, scale cars have been improved so that they are accurate and dependable and require the minimum of maintenance. The scales of these cars also have been gradually improved so that they are now very reliable and stand up under twenty-four hours per day service in a satisfactory manner. Various methods have been tried to prolong the useful life and to reduce the maintenance of these car scales by shielding them from accumulations of dirt and water. In some cases, these shields have consisted of deflector plates enveloping the entire car, and in other cases shields have been placed around certain parts of the scale mechanism. These have been only nominally successful. However, considerable advance has been made recently by designing the scales so that the main knife edges and bearings are enclosed in a steel housing which is part of the scale levers themselves. These important parts are very well protected, but at the same time are easily accessible for inspection. It is believed that this new construction will tend to still further reduce maintenance and maintain accuracy of weighing over longer periods of time.

Scale cars, of necessity, are of many types and sizes, each suitable for the particular stockhouse where it must operate. On this account almost every scale car is a customs made job, especially engineered to suit operating conditions. Modern tendency is decidedly towards the use of double compartment cars, and cars of larger capacity. Several of the newest furnaces are using cars of 40-ton capacity, which are the largest blast furnace scale cars yet built. However, cars of even larger capacity have been contemplated and can be built when the need arises.

While 40-ton capacity cars are the largest yet built for blast furnace charging, nevertheless a larger and heavier car has been built for handling charging buckets to an electric furnace. This car has a load capacity of 60 tons plus the weight of the bucket, and because of the shock load conditions involved in placing the large bucket on the car, it is equipped with a motor operated relieving device arranged to lift the load off the scale knife edges, excepting when the charge actually is being weighed. It is interesting to note that while the operation of the plant largely depends upon this scale car, still no spare car has been provided. This is a tribute to the dependability of modern scale cars.

It should be observed, while discussing scale cars, that their use is not confined entirely to furnace charging service, as transfer cars on the high line are sometimes equipped with weighing scales. This is particularly true of scale cars for handling coke from the coke plant to the blast furnace stock bins. A number of scale cars of this type are in service, all of them being of 30-ton capacity and of the side discharge type, as well as some cars for handling coal.

All modern scale cars, regardless of capacity, are equipped with dial type scales because the dial scale indicates at all times the load in the hopper and, consequently, enables the operator to cut off the flow of material in time to obtain the proper weight. Incidentally scale dials also are valuable because they automatically indicate any serious difficulty with the scales. If the scale pointer does not return to zero or moves in

Figure 1 — This 125-ton capacity strip handling car is moved by a heavy duty gas-electric tractor.

Presented before AISE Annual Convention, Cleveland, Ohio, September 28, 1948

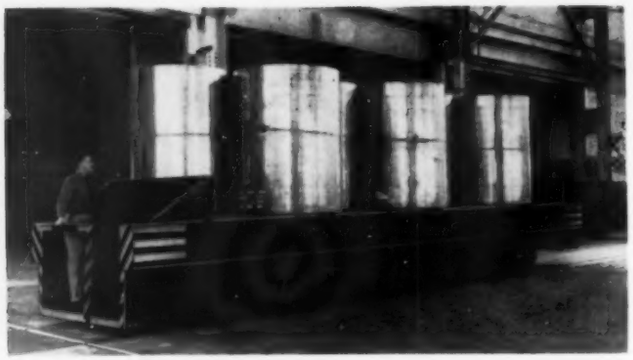


Figure 2 — A storage battery furnishes the power for this 125-ton strip handling car.

an erratic manner, it is a sure indication that there is rubbing friction somewhere in the scale mechanism, or dulled pivots, or other mechanical defects need correction.

Most of the dial scales in use are equipped with recording devices, electrically operated, to record the amount of each charge. These devices fall into two general classifications, one of which is intended for quick checking of the scale car performance, while the other is intended to produce a very accurate record of the actual weights of the various charges.

The first type, which is used for general checking purposes, produces a record by punctures made by a steel needle on a graduated chart about 6 in. wide. Because the charging round is repeated periodically the record forms a graph which is easy to check. Any serious deviations from the charging schedule become outstandingly prominent. This type of recorder is recommended for quick general checking of the operation of the scale car.

However, it is sometimes desired to check the material handled by the scale car against the material, actually delivered to the stockyard, and for this purpose a type printing recorder is used, which prints the weight of each charge in plain figures on a paper ribbon about 1 in. wide. This record provides the exact weight of the charges in figures and, therefore, provides the data necessary for an exact tabulation, but it does not give the quick overall picture of scale car performance which is shown by the chart recorder.

Each type of recording equipment has its own field and the instruments in service are about evenly divided between the two types.

Transfer cars—Next in the order of importance are the transfer cars used on the high line for filling blast furnace stock bins. These are often called "bin filling cars." Like scale cars, these are made in a variety of types and sizes with cars of 50-ton capacity predominating. Center bottom cars, which discharge their load between the track rails, are most common, but many side dump cars also are in use, some of them arranged to discharge the entire load on one side, while other cars are arranged to dump on both sides simultaneously, or by selection. An interesting new type is now being manufactured. This car is a combination center and side dump car. The hopper is divided so that part of the load may be discharged between the track rails and part outside of the track rails. The center and side dump compartments can be discharged simultaneously or selectively as desired.

There has been a tendency towards the use of larger transfer cars with the new large furnaces. It has been determined that a transfer car of modern heavy duty construction is most economical in the 65-ton capacity size. Such cars can be mounted on four-wheel trucks without exceeding good practice with regards to wheel and bearing loads. With any considerable increase in capacity beyond 65 tons it is necessary to use six-wheel or eight-wheel trucks. Usually under such conditions it is economical to build such cars of about 100-ton capacity and most of the larger transfer cars are 100, 110 or 120-ton capacity. The largest one in use is of 150-ton capacity.

Most of the larger cars of 100-ton capacity, or more, are mounted with two four-wheel trucks at each end of the car. The two trucks are connected by an equalizing bolster which distributes the load equally to all axles. This arrangement is preferred because it results in lower wheel and axle loads and also because the two four-wheel trucks at each end of the car can pass around the sharp curves sometimes found in steel plants more easily than six-wheel trucks, which have a longer wheelbase and introduce complications on account of the lateral displacement of the center truck axle when the car is on a curve.

Generally speaking these cars of larger capacity are used in connection with car dumpers, where it is part of the duty of the transfer cars to transport incoming stock from the car dumper to the storage yards as well as to fill the stock bins when operating in reclaiming service.

Some improved type transfer cars are now being built to include some features which have been dictated by past experience. These cars are of 65-ton capacity and will have trucks of heavy solid steel plate construction arranged so that the motors and other parts will be protected when the car encounters piles of ore or other obstructions on the track. By providing truck plates of 2 in. or more in thickness and with motors elevated to give greater clearance, it is expected that the maintenance of motor gears and cases and the brake rigging will be reduced greatly.

Figure 3 — This car for handling slag buckets is electrically operated.

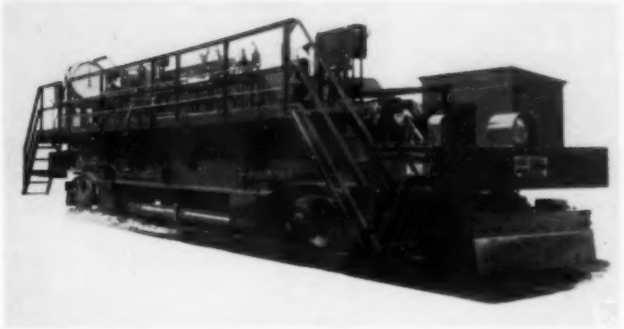


Figure 4 — This double compartment scale car is of 140-ton capacity.

These new cars will be hydraulically operated, being equipped with discharge gates and brakes operated by oil under pressure rather than the customary compressed air equipment. The hydraulic equipment is being provided to eliminate air compressors, which require considerable maintenance in steel plants, and more especially to give accurate speed control of the discharge gates. This is sometimes very important as it has been found in some cases that dropping a load of 50 tons or more into a bin nearly empty results in packing the material so tightly as to make considerable poking necessary on the part of the scale car operator. In one case the material so dropped had a tendency to spill through the bin louvers onto the stockhouse floor. The hydraulic gate operating mechanism provides complete control of the speed of discharge. The gates can be opened slowly and can be stopped in any partly opened position, which is not possible with pneumatically operated gates. It is not claimed that the gates of a large transfer car can be closed against the flow of the load when partly discharged.

The hydraulic equipment also provides an easy method of obtaining certain automatic safety features in connection with the brakes. The hydraulic brakes on these cars are arranged so they will be applied automatically in the event of power failure, and also will apply automatically in event that oil pressure drops below a safe limit, or in the event that a broken pipe or leak makes the operation unsafe. At the same time power is disconnected automatically, so the car is inoperative until it is again in a condition for safe operation. Hydraulic operation of discharge gates and brakes has been in use on scale cars for some years and has proved entirely satisfactory.

It is hardly necessary to mention that all modern transfer cars are equipped with electric heaters arranged to prevent material freezing in the hoppers of the cars during severe winter weather. These heaters have proved so successful that they are a "must" for a modern transfer car. The heaters are mounted in a manner which allows for expansion and contraction and still are easily accessible. They are enclosed in steel plate housings with thermal insulation provided to prevent the loss of heat. Heavy duty thermostats are used to maintain the temperature in the heated compartment.

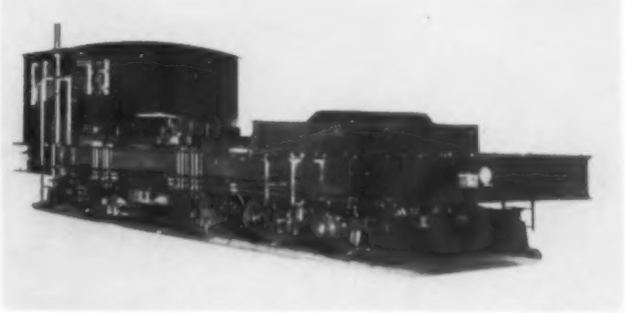
While it is not general practice, nevertheless a number of steel plants have found it expedient to equip their ore transfer cars with similar trailers. In this way one operator can readily handle two cars. When operating in this fashion it is customary to provide four traction motors on the power car so as to insure plenty of power for operating with a trailer.

Many transfer cars are equipped with pusher arms for moving coke or stone cars on the adjacent track of the high line. These pusher arms are power operated and are latched in the vertical clearance position when not in use.

Diesel-electric transfer cars—An interesting application has been made of transfer cars equipped with self-contained diesel-electric power. These cars are provided with two complete power plants, one at either end of the car arranged to operate in unison, or singly in an emergency. A cab providing full control is located at each end of the car. A corridor through the car allows the operator to move from one end to the other without descending to the ground. These cars are of the side dump type with three compartments and are of 120-ton capacity. They have been successful in service, but are handicapped by the fact that they operate over a system which is electrified and, consequently, the full savings which could be realized from complete elimination of the conductor rail system have not been obtainable. The maintenance of a conductor rail system is not an inconsiderable item. In spite of higher maintenance costs resulting from the use of the diesel engines, it is probable that such cars could show an overall saving if the installation were new so that the savings which would result from eliminating the conductor rail system entirely, together with the central station generating capacity necessary to operate the cars could be credited to transfer car operation.

Strip handling cars—A number of different systems has been developed for handling strip steel on cars. One installation includes double truck cars of 25-ton capacity which are operated on an oval track system by means of a gas-electric locomotive. Another installation for handling strip consists of double truck cars (Figure 1) of 125-ton capacity, which are handled by specially built gas-electric rubber tired tractors which are arranged to couple to the cars automatically and to give complete control of the strip handling car while the tractor is connected. Hand operated brakes are provided on the strip cars for holding them when they are parked without the tractor. This system was adapted because it was felt that two tractors could handle as many as eight or ten strip transfer cars since the cars move only intermittently. The tractors operate on rub-

Figure 5 — The 60-ton capacity bucket handling scale car is used in an electric furnace application.



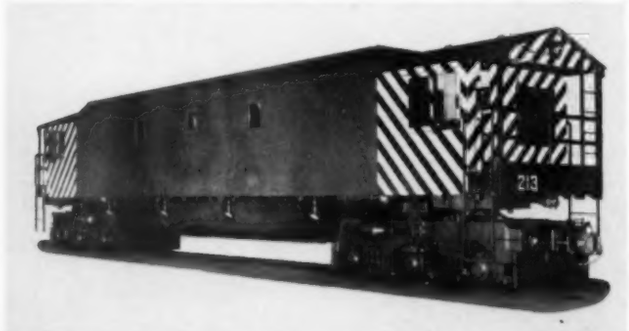
ber tires and can pass around the cars, thus avoiding considerable switching. The tractors are arranged to push or pull the strip transfer cars as the conditions may require.

A most recent installation for handling strip steel is a car of 135-ton capacity (Figure 2), which is self-contained and operates by storage battery power. This car is arranged so that the entire control is vested in a single lever which is the operating handle of the master control switch of the full magnetic, reversing-plugging controller. The car is propelled by means of a single motor driving one axle by means of a totally-enclosed triple reduction spur gear drive mounted on anti-friction bearings throughout. The car operates at a safe speed, and moves only so long as the master controller is held in the operating position. When released this handle automatically returns to the off position, whereupon a powerful magnetic brake on the motor armature shaft operates to bring the car to a stop very promptly.

This car is equipped with a self-contained fully automatic battery charging equipment which can be operated at any time or place by simply plugging into the plant power supply system. This means that, while the car is being loaded, or unloaded, or is otherwise standing idle, the battery can be charged. Actual experience indicates that with this arrangement, it is entirely feasible to operate storage battery cars in twenty-four hour per day service.

Battery operated cars—It is surprising to learn how rapidly the storage battery operated cars have come to be accepted for miscellaneous short haul jobs in steel mills since the new safety type of car has been developed. This safety type of car has proved to be the answer to many vexing transporting problems in steel mills. Most of these cars are of the "walk-along" type where the operator does not ride the car, but walks along with it, since the car cannot travel faster than a man can walk. Such cars are used for handling pipes, tubing, bars, and in combination with trailers, long pieces such as structural beams and angles. The control is vested in a single operating lever which must be held in the position the car is to move, but which automatically returns to the off position and applies the brakes when released. It will be apparent that such cars have valuable safety features in that they can at no time operate faster than a man can walk, and because of the control arrangement the operator positively must accompany the car. If he stops or releases the control handle the car stops at once. Most of these cars also are equipped with self-contained automatic battery charging equipment, which enables them to be used in intermittent transfer service for 24 hours per day. In fact this idea of including the charger on the car so that charging can be accomplished at any time or place has eliminated the principal objection to battery operation and has enabled these cars to operate continuously in intermittent service.

Figure 6 — Shown in the photograph is a 110-ton capacity, three-compartment, side dump, diesel-electric ore transfer car of the self propelled type.



Full advantage of the safety features and adaptability of these "walk-along" type battery operated cars has been utilized in a modern pipe mill for handling welded pipe through the processing operations. These cars, which include the usual features of the "walk-along" cars, are equipped, in addition, with special means for handling pipe. These cars have a bridging mechanism which can be extended on either side as required so that the pipe can be rolled from the assembly bunks directly onto the car. A power operated mechanism is provided on the car so that the pipes can be pushed off on either side when the car is unloaded. At the rounding mill the pipes are moved from the car endwise and on this account the car platforms are equipped with roller conveyors so that the pipe can roll endwise off of the car. These cars are provided with a safety interlock to prevent the car being moved while the bridge is extended beyond the normal clearance dimensions and limit switches are provided to control the maximum movement of the power unloading mechanism in both directions. This particular plant depends on these special battery operated cars for all handling of the pipe during fabrication, so it can be seen that there is confidence on the part of the plant management in the dependability of such equipment. This confidence results from a number of years of experience with battery operated cars for handling miscellaneous materials at the hot mills and in the structural yard.

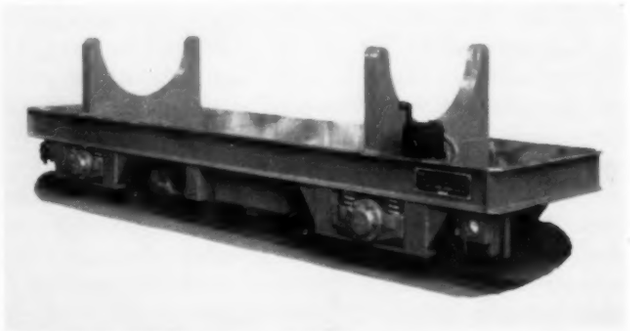


Figure 7 — Typical "walk-along" storage battery operated car of the safety type with single control lever.

Miscellaneous—In addition to the well defined service groups mentioned in the preceding paragraphs, there are many special cars used for miscellaneous purposes in steel mills. Among these may be mentioned special remotely controlled electrically operated cars for handling rolls. These are made in a variety of sizes to suit local conditions. Special electrically operated cars for handling buckets as shown by Figure 3 are also used. Cars for handling hot ingots are not unusual and some of these have been built with a capacity of 300 tons. Cars are often used to form the bottoms of annealing ovens. Such cars have been built up to 575-ton

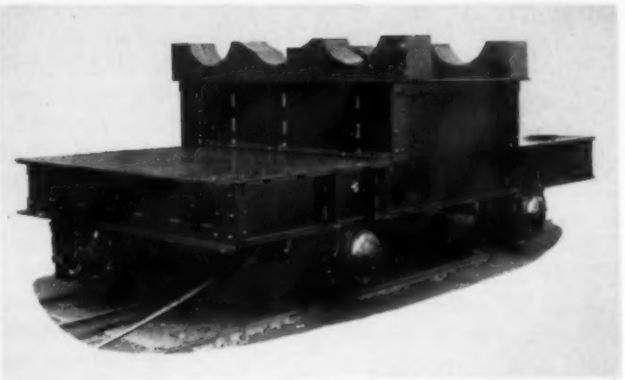


Figure 8 — The roll handling car shown is operated with a remote control.

capacity. A particular car of this type is equipped with a rack fastened to the bottom of the car which engages with a fixed pinion arranged to move the car in and out of the annealing oven.

Skip cars or skip buckets are really special service cars, as are a number of other types of machines which are not usually classed as cars, such as all-steel welded ingot handling chariots and special cars with hydraulic lifts used for handling coils of wire between certain definite levels.

It has been demonstrated that transfer cars of various types, and particularly the safety type of battery operated transfer cars previously described, cost less and can transport heavy materials at a lower cost per ton than any other type of materials handling equipment. At the same time they provide the convenience, flexibility and safety, which are so important in steel mills.

Special cars of all descriptions are helping to eliminate manual labor and to speed the handling of materials in steel plants and, consequently, are an aid in production. The types and designs of cars are limited only by the requirements.

DISCUSSION

PRESENTED BY

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C. J. KLEIN, Chief Engineer, Weirton Steel Co., Weirton, West Va.

BENJAMIN FROST, Arthur G. McKee Co., Cleveland, Ohio

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F. P. Krill: While listening to the paper, the thought occurred that the author has made the operation and maintenance of the scale car and bin car seem easy, which it is at present. It is not so many years ago that the old scale cars at Campbell had counterweighted doors and the mere closing of these doors was almost enough of a jar to throw the scales and dial out of whack.

Mr. Schellentrager kindly enough did not mention the things the operator should be responsible for to keep the scale car and bin car in good condition, so I will name a few. We will take the scale car first. The track should be of heavy solid construction with good foundation and drainage; the rails or track should be level and straight, and the joints kept tight with no loose bolts. This cuts side-sway and shock to a minimum. Water and moisture should be kept away from the car and one of the worst offenders is the fine coke dust floating around from the grizzlies or screens which settles everywhere and penetrates to all parts of scales and control. At Campbell, we are in pretty good shape on all of these items, except dust and we are getting ready to tackle that presently.

As for the bin car, we have our tracks in good shape and about the only errors we commit here are that the bins are sometimes filled too high with ore in the winter and the car has trouble ploughing the frozen ore off the track. The other bad thing is to push or pull cars on the track adjacent to bin car track.

Mr. Schellentrager also brought up the conductor rail collector system and I agree with him that it is something we should be without. We scrapped ours about fifteen years ago and we never regretted it. At Campbell we now use a gas-electric engine for power and at Brier Hill we use a fireless steam locomotive. Both are satisfactory in their operation. At Campbell, we have never been able to use electric heaters and stick to the old fashioned coke jacks. We do not know what is wrong but we blame it on the voltage available from the engine which is only 32 volts.

There are two other items I would like to mention and the first is—do not habitually overload your cars.

The other item is that they should positively be self cleaning. I will explain this last statement a little more fully. About two years ago, we bought two new ore bridges for Campbell and one of the important things we wanted on these bridges was a bin holding about 60 tons on the furnace end so that the bin car would not have to wait for the ore bridge trolley to load it. It was suggested that we use the same design that was on the Brier Hill bridge which has an ore bin of 100-ton capacity with a roller discharge. This had proved very satisfactory for them. We went up to investigate it and found out that during cold, wet weather, the bin would plug up the same as an ore bin with from 5 to 10 tons of ore sticking to the sides and corners. This did not affect the operation at Brier Hill because all they made was basic iron, but it would not do for Campbell. What we finally put in was a bin the same as the bin car with a motor operated gate and it has proved very satisfactory.

We have not made any changes in our last scale cars or bin car since they were purchased except to change the thickness of the bin car wearing plates from ¾ to 1 in. on account of using so much sinter which is about 20 per cent of the burden.

There is no question that the modern bin system and scale car is a long way ahead of the old fashioned hand barrow holding 1500 to 1700 lb of ore, hand filled and one or two man power pushing or pulling it.

E. W. Schellentrager: It is noted that Mr. Krill is fully aware of the desirability of maintaining scales on blast furnace scale cars in good operating condition and well protected from dirt, and especially coke dust. He will soon have an opportunity to inspect the improved sealed type knife edges which have recently been developed for our scale cars as this latest type of seals will be mounted on cars we are now building for Campbell Works.

We are much interested in Mr. Krill's statement that he has not been able to use electric heaters on his cars successfully. No doubt he will be interested to know that this matter is one of the chief complications which has tended to delay the more general use of diesel-electric self-propelled cars. This matter has been given serious consideration. It is not reasonable to expect to operate car heaters from the ordinary starting and lighting system of most locomotives. In fact the power requirements are such as to demand a considerable horsepower be made available for heating purposes when needed. It must be borne in mind that when the heaters are needed, it may not be for any long period during the winter, but nevertheless they are needed very badly and while they are in service the power demands are practically continuous. On this account the usual locomotive ratings of the diesel engines cannot be used. The continuous ratings of these engines are much lower than the intermittent traction ratings just as the continuous rating of the traction motors is much less than the one-hour rating which is used in establishing rated tractive effort.

Attempts have been made to work out an arrangement whereby it would be possible to utilize engine power for heating while the car is not moving. This would not prove successful due to two factors. In the first place to operate the engine on a heating load when it otherwise would be idling immediately reduces the rating to the continuous basis, which is not satisfactory for traction purposes. Secondly it has not been determined that intermittent operation of the electric heaters will produce satisfactory results in severe weather.

There is, of course, considerable heat lost in the engine exhaust and in the cooling water and some thought has been given to attempting to recover this heat and apply it for hopper heating purposes. However, the same objection applies here, which is that the service conditions might be such that proper heating could not be obtained because of excessive idling periods. Very little heat is available during such periods.

It is the writer's belief that the solution of this problem lies in supplying an additional engine-generator set to be used exclusively for heating purposes. This set could be a duplicate of the traction drive equipment and could be mounted on the car or, if desired, on a small trailer car. This engine-generator set would serve as a spare equipment, which could be used for traction purposes during the summer months when the regular traction units are undergoing their periodic maintenance overhauling.

C. J. Klein: It is noteworthy to observe how the capacity of these cars has gradually increased in order to take care of enlarged operations of various types, and also that as the size of the cars increased, the design and development of drives, bearings, wheels, axles, and electrical equipment have progressed so that the driving equipment in general has not increased in physical size as materially as the car loading capacities.

We note that diesel power has entered the picture in a number of cases, and indications are that this type of automotive equipment is preferable to electric motor drives with collector systems.

We have recently discussed at our plant the pros and cons of installing power conveyor equipment for the transfer of ingots from a unit of soaking pits which now serves the 40 in. blooming mill so that these ingots could also be transferred to the approach table of the 35 in. blooming mill for processing—these units being about 200 ft apart. In order to install a conveyor system it would have to be placed underground due to floor level interferences. The installation of a collector system for electrically operating an ingot car was also objectionable as this system if placed above ground would interfere with crane operation, and if placed below ground would be subjected to damage and the filling up of the pit due to the handling of materials above it. An investigation disclosed that the most economical type of power transfer equipment would be a small diesel locomotive which would have attached to it a flat car onto which the hot ingots could be placed for transporting between the two locations. This installation has proved quite satisfactory.

Another recent installation was made in our bessemer converter department for the handling of the converter shell for relining. Up until recently the converter relinings have been done on their original stands, there being two of these 25-ton converters in our plant. Sufficient space was not available in the converter building for the placement of a spare stand for the relining of the vessel. However, space was available adjacent to this building if the converter could be handled into this location. After a review of the conditions it was decided to install a car which would transfer the shell complete with its lining from one building to the other. This car, which has been built and placed into operation, has an overall width of 27 ft 3 in. and an overall length of 16 ft 2 in.—the platform of the car being 3 ft 4½ in. above the rail, and the stands for supporting the converter shell being 19 ft 4½ in. above the rail. The total height of the unit when the converter shell is in place is 26 ft ¾ in. The converter shell together with its lining and miscellaneous appurtenances weighs 120 tons—the total weight of the car is 140 tons. The converter shell is not lifted from the car in the building where relining is done. The method of procedure for relining consists of removing the old lining and placing a new lining into the converter shell with the unit mounted on the car. Drying out of the shell is then done and the relined vessel is ready for service as required. A car puller is provided for moving the car back and forth.

In addition to the proper design and construction of scale cars we find that it is improtant to provide substantial foundations for the mounting of the rails for these cars. If this is not done the tracks are permitted to become uneven or out of gage, thereby causing considerable maintenance in the operation of the car.

E. W. Schellentrager: It is interesting to note Mr.

Klein's remarks regarding the small diesel locomotive and flat car for handling hot ingots. It is a question whether one of the safety type storage battery operated cars might not be as economical for this service. There is no question that it would be more reliable and much more simple to operate, besides requiring less maintenance.

Benjamin Frost: Mr. Schellentrager has presented a very complete paper on a subject of particular interest to those having anything to do with the charging of a blast furnace or stocking raw materials for a blast furnace plant. While the use of special cars in the steel industry is not limited to the blast furnace department, scale cars and transfer cars do represent very important links in the flow of raw material in a steel plant.

Besides the requirements of accuracy of weighing and continuity of operation which are scale car features of primary importance to operators and maintenance men, the arrangement of the car hoppers with respect to the bins is also highly important. This one factor has a great effect on the actual usable capacity of the scale car hoppers and at times can be the factor controlling the actual filling cycle used on a blast furnace. It is, therefore, necessary that the scale car hopper capacity be approximately equal to the skip car capacity and that the car and bins be arranged to fully utilize the volume of this hopper, if complete flexibility of charging is to be maintained. This factor will become of increasing importance in the future if sinter and other beneficiated raw materials of relatively low density make up a large part of the furnace burden.

In most furnace plants at the present time, we find that a full skip of ore is not often required, but with beneficiated raw materials, particularly air-cooled sinters, it may become necessary to provide for large volumes of material in the charge. For that reason, it is important that the scale car hoppers have an as filled volume equal to that of the skip car.

One of the reasons for using a tailor-made car for each type of stock house is the effort to make the best use of the car hopper capacity in that stock house. Other reasons are to put the operator's platform at the best location for ease of gate operation and convenience to charging controls. These requirements have resulted in many demands on Mr. Schellentrager's ingenuity and good nature which he has always been able to meet.

Transfer cars, while equally as important as scale cars in keeping a furnace filled, do not have to meet as many exacting requirements. They too, however, are often tailor-made to provide the right bin filling and are often powered to serve as locomotives for moving cars on the high line.

There is another factor which is of importance as regards scale car maintenance which has not been taken care of in many plants. That is the method of setting and joining rails in the scale car track. In a few plants it has been found advantageous to set the scale car rails on steel beams imbedded in the floor and to weld the rail ends. This procedure provides a much evener and smoother track, thus increasing the accuracy of weighing and improving the life of knife edges.

E. W. Schellentrager: From the standpoint of the scale car manufacturer it is very pleasing to note that Messrs. Krill, Klein and Frost all have emphasized the necessity of providing the scale car tracks with a good foundation and maintaining them in good condition and as level as possible so as to insure accurate weighing on the part of the scale car.

P. C. Vetter: Our 1946 and 1947 expansion of the cold strip and annealing departments increased the floor area from 360,000 to 846,000 sq ft. In a plant of this size, the transferring of the strip from the tandem mills to the annealing department and thence to the finishing department is a major problem, and it gave us considerable concern.

Conveyors were first considered, but the idea was discarded because of the high first cost, and the obstruction which conveyors present to any cross traffic in the mill. Also, in the handling of coils 92 in. wide, having a maximum weight of 25 tons, any conveyor designed to carry such loads would have to be excessively heavy to compensate for the shocks resulting from handling such loads.

We got the idea for using cars and tractors from a picture shown on page 318 in the Association's book, "The Modern Strip Mill." The picture was taken at the Irvin Works of Carnegie-Illinois Steel Corp., where

Figure 9 — Tractor used for handling in strip mill and annealing departments at Great Lakes Steel Corporation.

Figure 10 — The coil transfer car is of 125-ton capacity.

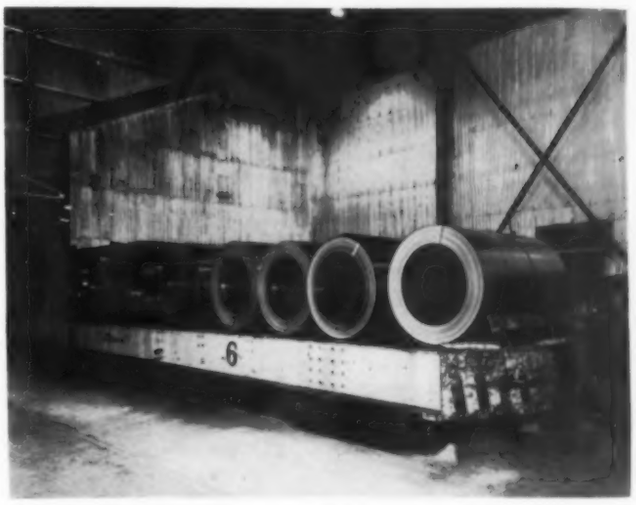
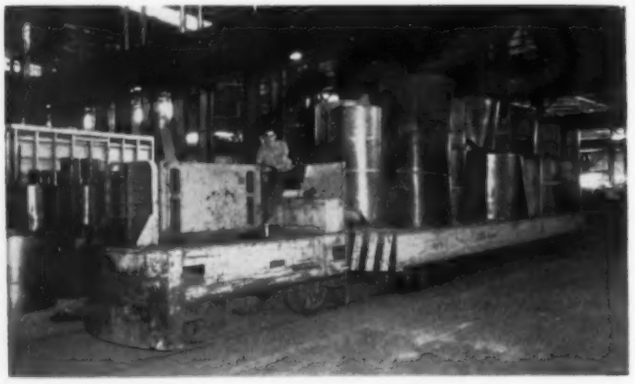


Figure 11 — Coils may be either loaded on their sides or on their ends as shown in this and the previous figure.

Figure 12 — Note that the tractor hauling the car is rubber tired.



they are using a farm-type tractor to push the coil and sheet transfer cars. Their cars and tractors were originally furnished with automatic couplings, but the couplings were abandoned due to high maintenance cost.

Through the courtesy of Mr. Klaus Egge, who was then chief engineer of the Irvin plant, the speaker, with our vice president in charge of engineering, Julius A. Clauss, visited the Irvin plant to view this transfer car and tractor. We were generously furnished with drawings of their equipment and received many helpful suggestions from them.

With this information, and the knowledge of our own local conditions, we decided that a transfer car properly designed to carry 125 tons of coils, built heavy enough to stand the shock loads from the handling of 25-ton coils with magnets, would be a suitable piece of equipment provided we could design a tractor of sufficient capacity with sufficient braking power to stop the loaded car.

In order to provide flexibility, we specified that the tractor must be able to push or pull the loaded car and be equipped with rubber tires to operate on the wood block floor of this department.

In the arrangement of our cold strip mill and annealing departments, one main transfer track runs practically the full length of the building and is provided with turnouts to the loading and unloading stations. The other tracks run at right angles and are used to transfer the strip from one building to another. In order to provide sufficient flexibility for the tonnage to be handled, we required eight transfer cars and three tractors. We asked Mr. E. W. Schellentrager to design these cars and special gas-electric tractors for us that would either push or pull the transfer cars over the track system of our cold strip department. The tractors were to be provided with automatic couplings, front and rear, which could be operated from the driver's seat. We determined that these tractors would have to have a 1500-lb draw bar pull. The tractors were to be equipped for gas-electric units, having 16 hp motors which would give a tractor speed of 3 mphr.

Figure 9 shows the tractor as furnished. Both ends of the tractor are provided with a counterweighted coupling hook which slides under the end plates of the transfer car. The hook can be released by means of a foot pedal from the tractor operator's seat. The tractors have solid rubber tires and can be used on any part of the cold strip mill track system.

Figure 10 shows the transfer car loaded with coils on their sides. These coils are being transferred from the tandem mills to the annealing department.

At the annealing department, the coils are upended, annealed and again loaded on transfer cars for shipment to the finishing department. This time the coils are loaded on end, as shown on Figure 11.

The cars are also used for sheets, which are to be shipped to the finishing department. Figure 12 shows the tractor coupled to car loaded with coils. The ends of both the car and tractor are rounded to provide for the swing of the cars in passing through the turnouts.

Because of the poor soil conditions at our Great Lakes Steel plant, any equipment not placed on piles will settle. To provide for raising and realigning the track and to spread the transfer car wheel loads, the track was installed in a concrete tub. Figure 13 shows a typical cross-section of the track installation.

The reinforced concrete tub was first built, the track installed on wood ties, and then ballasted to grade with blast furnace slag. The tub construction, which extends under the entire length of the tracks, makes for a more uniform distribution of the load, and provides a simple means for keeping the tracks level and true should settlement occur.

It is obvious that with the heavy loads to be transferred, the track had to be practically level at all times if the installation was to be a success. By removing the brick paving between the tracks and the edge of the tub, it is a simple matter to tamp the ties and bring the track to its original lines when necessary.

The floor between the rails and between the rails and walls of the tub was paved with brick and cement grouted. This paving, with the street car rails and flush type switchpoints, provides a smooth roadway for the

Figure 13 — Typical section through transfer track.

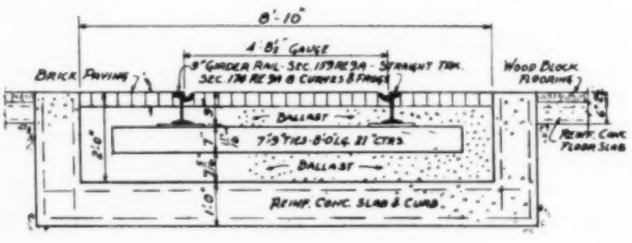

8'-10"
4'-8½" GAUGE
9" GIRDER RAIL - SEC. 179 RE 34 - STRAIGHT TRK.
SEC. 174 RE 34 @ CURVES & FROGS
BRICK PAVING
WOOD BLOCK FLOORING
BALLAST
7"x 9" TIES - 8'-0" LG. 21 "CTRS.
BALLAST
REINF. CONC. FLOOR SLAB
REINF. CONC. SLAB & CURB

Figure 14 — A turnout under construction is shown in this photograph.

transfer car tractors and also the other tractors and traffic of the cold strip department.

Figure 14 shows the installation of the track at one of the turnouts, and shows clearly the type of construction used.

The entire installation, consisting of about three-quarters of a mile of track, three tractors, and eight transfer cars, has now been in service about one and one-half years and has proved entirely satisfactory.

E. W. Schellentrager: While the transfer cars used at Great Lakes Steel plant for handling strip steel are not scale cars, nevertheless, it is interesting to know that Mr. Vetter's company has realized the importance of good track conditions to insure satisfactory operation and, therefore, has placed the car tracks in a reinforced concrete trough arranged so that tracks can be ballasted to proper level should this become necessary. It is to be noted that with modern roller bearing cars, this is an important consideration because such cars will move on grades which would never cause cars with plain bearings to coast. It is for this reason that these cars are equipped with parking brakes, although the brakes of the tractor are used for service stops.

R. W. Gerhardt: About two years ago Mr. Schellentrager's company was called upon to supply a car for an electric furnace going into the Bethlehem Pacific Coast steel plant, at Los Angeles. I think that car was shown in one of the figures. He mentioned in his remarks that we thought so well of that car that we did not see fit to supply a spare. That was because extra charges for the furnace were kept under the charging crane for 24 hours operation, thus permitting ample time for car repairs.

It would be interesting to learn if Mr. Schellentrager can submit a design of a special car to carry a large flywheel motor generator set to act as an emergency spare for driving a reversing rolling mill. Such a portable unit would be a wonderful help and avoid extended mill delays when a bad failure occurs to the regular mill driving set.

E. W. Schellentrager: There is no reason why a car could not be built to handle a motor-generator set for emergency service. In fact such cars have been built and were used during the recent war to supply emergency power. They are of various types, some of which include a complete steam generating plant mounted in a number of cars to form a continuous train. Such cars saw service in Europe during and after the war. Quite a number of them were shipped to Russia.

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Development of Steep Rock Iron Mines

. . . . in addition to the usual problems of developing an iron mine, the Steep Rock ore body was located at the bottom of a lake . . . .

By W. SAMUEL
Consulting Engineer
Steep Rock Iron Mines, Ltd.
Toronto, Canada

▲ THE iron bearing ranges of the Lake Superior district lie to the south and to the west of Lake Superior. First iron ore was discovered in 1845 on what is now the Marquette Range, Michigan. Shortly afterwards, ore was found on the Menominee and Gogebic Ranges of Michigan and the Vermillion Range of Minnesota. The Mesabi and the Cuyuna Ranges of Minnesota were discovered in 1893 and 1912, respectively. From these discoveries developed the huge ore mining and transportation system of today, whereby an annual average of about 50,000,000 tons of ore increasing to 90,000,000 tons during war years has been mined and shipped by rail to Lake Superior ports, and from there by lake boats to ports on Lakes Michigan, Erie and Ontario for transfer to the blast furnaces of east-central United States and Canada.

To the west of Lake Superior, the boundary between Canada and the United States passes about 25 miles north of the Vermillion Range and about 60 miles north of the Mesabi Range. It is natural therefore, that for the past 60 to 80 years, much attention has been paid to the possible presence of comparable iron ranges in Ontario, north of the Minnesota boundary.

In the 1800's the main travel route from Lake Superior to western Canada passed close to, if not through Steep Rock Lake, and one often wonders if some of the voyagers did not take east with them occasional specimens of float iron ore which were plentifully distributed along the beaches of the south shore of Steep Rock Lake and over the country to the south and southwest of the lake for a distance of four miles.

Messrs. Smith and McInnes mapped the Seine River area for the Geological Survey of Canada and their map, published in 1897, contained the following note:

"An iron bearing horizon with hematite of good quality appears to be generally covered by the waters of the (Steep Rock) Lake."

Mr. Jules Cross, a mining engineer, prospector, from Port Arthur studied the possibility of finding iron ore in the lake bottom for a number of years. Bringing the proposition to the attention of the late Joseph Errington resulted in the discovery of high grade iron ore early in 1938 by drilling vertical diamond drill holes from the lake ice.

It became apparent early in the exploration of the property that the ore bodies were of such size that open pit mining was warranted and that it would be necessary to remove the water from the ten mile long eastern portion of Steep Rock Lake. In order to do this, it was first necessary to arrange for the abandonment of a power plant generating up to 10,000 hp, situated on the Seine River at the head of Steep Rock Lake and to move the Seine River two miles westward for eight miles of its course, thus removing the river from the portion of Steep Rock Lake in which the ore bodies occur.

The diversion required the excavation of two canals in rock, a deep earth cut, the lowering of twenty mile long Finlayson Lake fifty feet to the elevation of the new river channel. This was done by breaking through a large tunnel from low ground into the lake bottom, the construction of spillways, control works and coffer dams. To reach these works, it was first necessary to build twenty miles of motor road. Road construction was started in March, 1943, and the river diversion was complete in about nine months.

While this work was in progress, the Ontario Hydroelectric Power Commission built a power line from Port Arthur to Steep Rock Lake one hundred and forty miles long. The Canadian National Railway built a spur line from Atikokan to the mine crusher and loading terminal, and the Dominion government commenced construction of the ore docks at Port Arthur.

Fourteen 24 in. electrically driven centrifugal pumps using 7000 hp of electrical energy were used to lower Steep Rock Lake six inches daily. The lake lies in a rock

A portion of the bed of Steep Rock lake is shown after the water was removed.

Presented before AISE Buffalo District Section Meeting, October 12, 1948

basin and there were no water flows from outside the lake basin itself. After pumping had continued for some time, removal of the clay silt overburden from over the "B" ore body was started. Some trouble was encountered early in this operation owing to the wet soft nature of the silt immediately below the lake bottom. However, this material has all been removed from the vicinity of the "B" ore body and the removal of earth for the full development of much of the "B" ore body is almost complete.

Ore production began in May, 1945, and during that ore shipping season 505,375 tons of ore was forwarded to eastern consumers. In addition to this, a large program of earth removal was carried out to enlarge the open pit area. In 1946 830,481 tons of ore were shipped. In 1947, 1,206,246 tons of ore were produced. It is expected that production will be maintained at about 1,000,000 tons annually for the next few years while the "A" ore body is being opened up. When this ore body is fully developed, production from the two ore bodies should be stabilized at around 3,000,000 tons annually.

Exploration to the present has shown the presence of three iron ore bodies in the bed of Steep Rock Lake, two of which have been explored in detail. The "A" ore body is over four thousand feet long and from two hundred to five hundred feet wide. The "B" ore body is also over four thousand feet long and from one hundred and fifty to three hundred feet wide. This year, the company estimates 71,500,000 tons of proven and probable ore in the "A" and "B" ore bodies to comparatively shallow depths, most of which will be mined by open pit workings.

Estimate of grade of ore reserves is:

	Per cent
Iron	59
Phosphorus	0.028
Silica	5.9
Sulphur	0.048
Alumina	1.00
Manganese	0.15
Loss of ignition	8.50
Moisture "B" orebody — 10-11 per cent iron material	52.50
Moisture "A" orebody estimated 9 per cent iron material	53.75

The grade of these reserves compares very favorably therefore with the reserves of direct shipping ores on the American ranges.

The "A" and "B" ore bodies are nearly vertical in altitude and should continue to much greater depths than those used in the ore reserve estimates quoted above, this ore becoming available through underground workings. These ore bodies also are as yet not limited in length. The "C" ore body is largely unexplored and does not enter into ore reserve calculations. Geological conditions suggest the presence of further ore bodies in the lake bottom, as yet unexplored. The property might therefore be regarded as an iron range comparable to one of the American iron ranges with a number of iron mines, rather than a single mine. It is likely that the tonnage of ore ultimately mined from Steep Rock will greatly exceed the presently estimated reserves.

DEVELOPMENTS IN HOT-TOP DESIGNS*

By E. W. PIERCE, Chief Metallurgist
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Carnegie-Illinois Steel Corp.
Chicago, Illinois

▲ EXTENSIVE experimental work with hot tops, in regard to their efficiencies, has been done at South Works. Early investigation with standard clay and standard C&D hot tops revealed that volume ratios—hot top to total ingot volume in the molten state—of approximately 15.5 and 14.0 per cent, respectively, were the lowest possible for satisfactory product. This work indicated that further increases in product yield, from hot-topped ingots, could be obtained only by a more efficient hot top.

Most recent investigations have been with a number of different tops on a 25-in. by 25-in. by 68-in. big-end-up mold. These are insulated clay hot top, restricted C&D hot top, experimental clay hot top, and cement hot top.

All of these various types have been used in production runs and, based on shear observations, transverse macro-etch tests and actual rejections, the following relative efficiencies represent experience to date. The solid standard clay hot top is considered as a basis for comparison in each case.

The insulated clay hot top, based on quality, produces a top product comparable to that of the standard clay, with a reduction in hot-top volume of approximately 2.4 per cent. Care must be observed in handling this type due to excessive cracking and breakage. Chipping during setting requires additional mold cleaning.

The restricted C&D top, based on quality, produces a top product comparable to that of the standard clay, with a reduction in hot top volume of approximately 2.4 per cent. Proper preparation of this top is required prior to setting to eliminate need for mold siphoning before use. This top affords more flexibility in pouring height. Additional work with this top on larger big-end-up ingots has produced satisfactory results.

Results of the small sample of experimental clay hot tops showed these to be inferior to standard clay tops. The cement hot top has been used only on trial runs to date.

*Condensation of a paper presented at the National Open Hearth Steel Committee meeting sponsored by the American Institute of Mining and Metallurgical Engineers, in Chicago, Ill., April 19, 1949.

NON-CONTACTING X-RAY THICKNESS GAGES

. . . . the X-ray thickness gage gives the operator an opportunity to correct conditions which may cause off-gage strip when they occur, thus reducing scrap losses . . . .

By H. S. MAXWELL
and
C. W. CLAPP
General Electric Co.
Schenectady, N. Y.

▲ A means of continuously gaging the thickness of hot rolled strip during production has been needed since the advent of continuous hot strip mills. With hand gaging, a modern hot strip mill will frequently roll several slabs into off-gage strip, with resulting expense of reapplication to other orders, before the first strip to be coiled can be gaged with hand micrometers. "One-spot" gaging is inherently inadequate because of the many factors that can affect the thickness of strip while it is being rolled.

An X-ray thickness gage now available makes possible continuous production of on-gage strip by continuously and accurately indicating the deviation of the thickness of the strip from the required thickness as it leaves the last finishing stand. It becomes a simple matter for an operator to hold the thickness of the strip within close tolerances by observing the trend of deviation and making progressive screwdown adjustments.

In addition to the need for a gage for hot strip mills, a need for non-contacting electrical gage for cold strip mills has developed during recent years as mile-a-minute delivery speeds have been approached and exceeded.

When a beam of X-rays strikes a sheet of some absorbing substance such as steel, a part is transmitted through the sheet unchanged while the remainder is absorbed within the sheet except for a negligible portion which is re-radiated as scattered X-rays. Equal parts will be transmitted if beams from a common source of X-radiation pass through sheets of the same material having the same thickness. This is the basis of the gage design.

Gages for hot strip mills and gages for cold strip mills have the same electrical design with similar but somewhat different mechanical design. An X-ray tube rated 100 kv peak anode voltage and requiring oil for insulation and cooling is likely to be required for the strip thickness to be measured in most hot strip mill applications, whereas an X-ray tube rated 50 kv peak anode voltage, air-insulated, with water cooling, will be adequate for most cold strip mill installations.

Presented before AISE Annual Spring Conference, Buffalo, N. Y., April 26, 1948 and AISE Detroit District Section Meeting, February 28, 1949.

HOT MILL GAGE

Components of a 100 kv gage designed for hot mill service are shown in Figure 1. The first gage of this type was placed in operation in September, 1947, on an 80-in. hot strip mill. The gage is located on the delivery side of the last finishing stand and as near the stand as practicable.

The tank containing the X-ray tube is arranged to be rolled into the operating position beneath an apron plate. The measuring beam of X-rays is directed vertically upward through an opening in the apron plate. The top detector is located in the path of the measuring beam, above the strip. The gage measures thickness of steel passing over the opening in the apron plate.

Tank and top detector are connected electrically with a control panel conveniently located in the motor room. A gage indicator, which indicates the strip thickness desired, and a deviation indicator, which indicates the deviation from that thickness, are located at the operator's position. Additional deviation indicators may be located remotely if desired. Control switches are located on the operator's desk or cabinet. A flow panel for circulating cooling oil is mounted remotely.

Specifications of this gage are:

X-ray tubes—100 kv peak, 7 ma.
Range—0.040 to 0.190 in. of steel.
Accuracy—plus or minus 2 per cent.

Operation—Figure 2 shows a block diagram of an X-ray thickness gage. The wedges shown are long tapered metal plates with flat ground faces. Each wedge can be driven back and forth across its beam to place the desired thickness of metal in the path of the beam.

As strip passes, the deviation wedge is positioned

automatically by a servo-motor to maintain the relation:

Deviation Wedge Thickness+Strip Thickness= Gage Wedge Thickness

The operator watches the deviation indicator as it follows the continual repositioning of the deviation wedge.

The X-ray tube transmits two beams, the reference (horizontal) beam passing through the gage wedge to a multiplier phototube in the bottom detector which is inside the X-ray tank. The measuring beam passes vertically upward as previously mentioned, through the deviation wedge and through the strip to a second, identical, multiplier phototube in the top detector housing. The effective portion of the measuring beam is of cylindrical shape, approximately one inch in diameter.

Each phototube compares the light falling on it from a phosphorescent screen, made to glow by the X-radiation, with the light from a standard light source. A discharge lamp mounted near the phototube in the top detector, and an identical discharge lamp mounted near the phototube in the bottom detector are the standard light sources. These lamps have a common power supply.

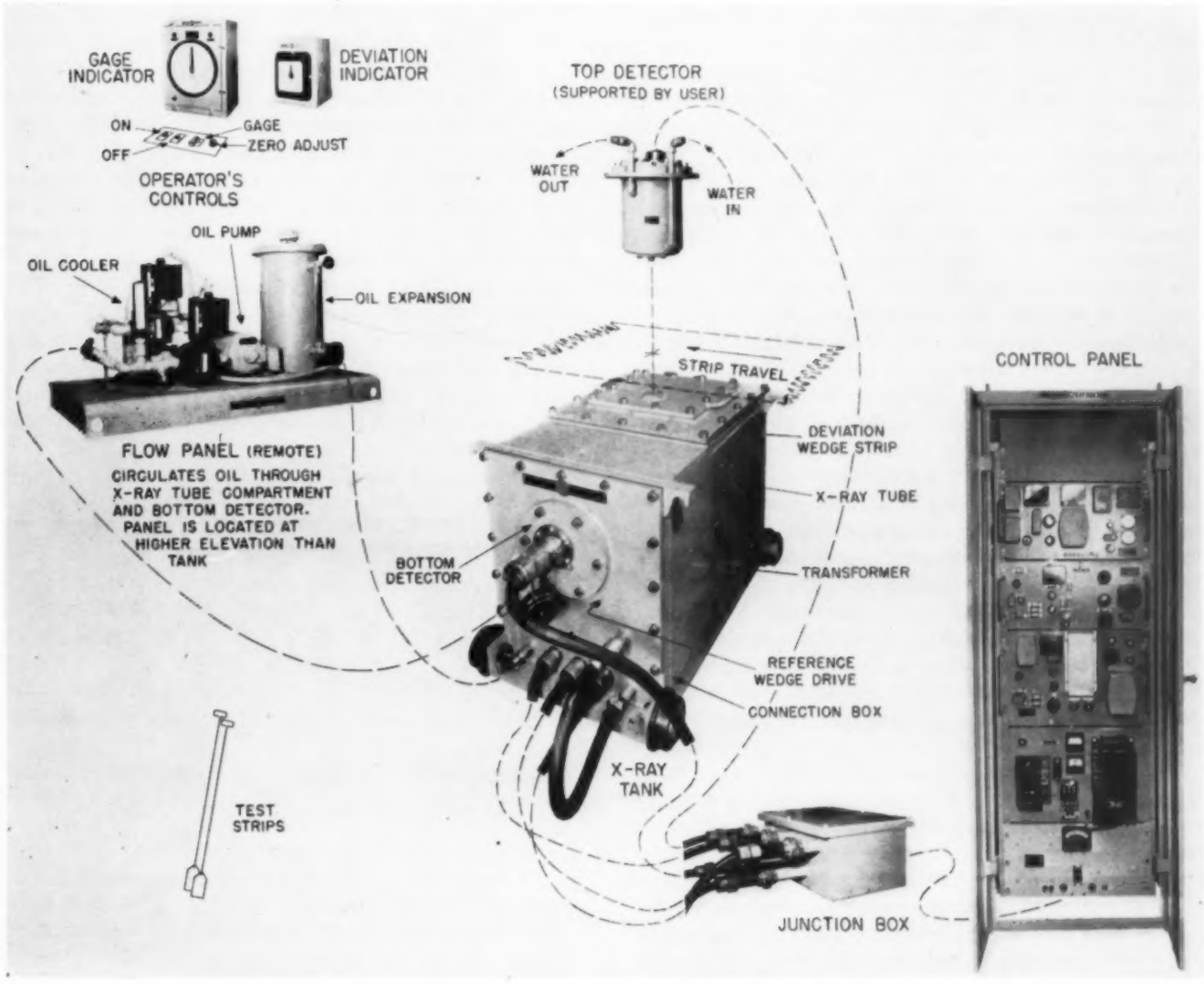
X-radiation is omitted during each positive half-cycle of the 60 cycle supply, and standard light is emitted during each negative half-cycle.

In the bottom detector, any difference of light intensity causes a sensitive automatic regulating system to adjust the high voltage supply to the X-ray tube. As the operator changes the thickness which the gage wedge presents to the reference beam, the regulator changes the tube voltage. This adjusts the penetration of the X-radiation to maintain constant X-ray energy at the phosphorescent screens.

Any difference in light intensity in the top detector causes an automatic positioning system to reposition the deviation wedge until the difference is zero. The position of this wedge is therefore, always a function of the strip thickness, and by means of an electrical transmission system the difference between actual strip thickness and desired strip thickness is indicated on one or more dials.

The gage thus contains a position regulating system and an auxiliary voltage regulating system. Both are

Figure 1 — The non-contacting X-ray thickness gage is broken down into its component parts in this view.



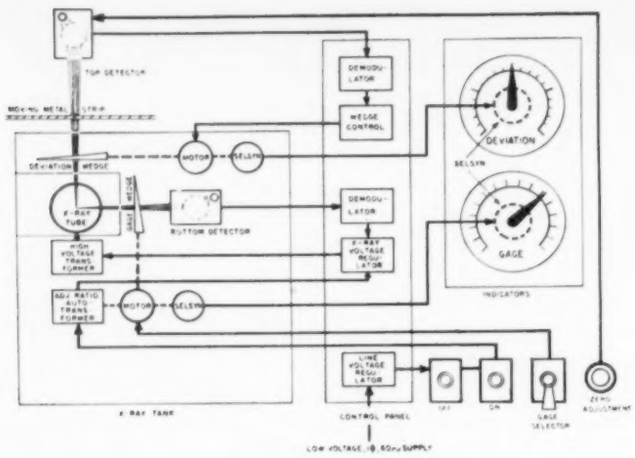


Figure 2 — Block diagram of thickness gage.

continually regulated to reliable references so that the only possible drift is the drift between references.

An occasional check of accuracy may be made by placing a test strip of known thickness in the measuring beam. If the deviation indicator does not read zero, it can be brought to zero with a potentiometer rheostat. This process requires less than a minute and is the only calibration check required.

To set the gage for a different nominal steel thickness the operator merely closes the reversing gage selector switch and watches the gage indicator until the servo-motor has driven the gage wedge to the desired position. The servo-motor simultaneously drives an adjustable ratio auto-transformer to adjust X-ray tube voltage to a correct value for the new setting.

Scales are direct reading and, since wedges have uniform taper, are essentially linear over the full range.

Performance—All supply voltages used in the vacuum tube circuits of the gage are regulated to insure stability during line voltage changes.

Multiplier phototubes used in the two radiation detectors are known to change in sensitivity as the result of comparatively small changes in their electrode supply voltage. On the other hand, their high sensitivity as compared with other radiation detectors permits operation of the gage at a comparatively low level of X-ray intensity, thus simplifying the problem of stray radiation. To overcome the effects of changes in sensitivity, the tubes are required merely to compare the 60-cycle pulses of light coming from the X-ray excited phosphor with pulses of constant-intensity light from the stable reference light source and to indicate which is the stronger. Even quite substantial changes in sensitivity of the phototubes or their associated amplifier circuits have, therefore, an insignificant effect on the reading of the gage.

The sensitivity, speed of response and freedom from drift of the gages now in operation, meet mill requirements with regard to electrical performance. For example, the hot mill gage now in operation can detect deviations of less than 0.001 in. in strip 0.100 in. thick, which is well within present commercial tolerances for hot bands. The sensitivity is sufficient to demonstrate the slight increases in thickness resulting from cold spots in the slab at points where slabs have lain on water-cooled ways in the slab-heating furnace.

The rugged construction of the X-ray tank and top detector of the hot mill gage now in operation is shown in Figure 1. Obviously this illustration cannot show the severe conditions under which the gage operates, which include radiant heat from 1500-1750 F strip, a deluge of water from cooling sprays, steam, the fog of iron oxide sometimes present, and an occasional "cobble."

COLD MILL GAGE

The second gage placed in operation was installed on the world's highest speed cold strip mill, located between the last stand and winding reel. Because no cold mill gage design was available at the time, this gage has the mechanical design of a hot mill gage, but operates at voltages below 50 kv. Specifications are:

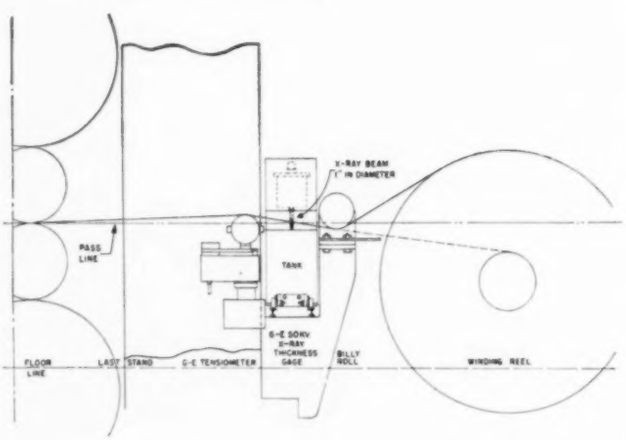
Range—0.005 to 0.027 inches of steel.

Accuracy—plus or minus 2 per cent.

Figure 3 shows a typical location for a cold mill gage, between the last stand and the winding reel, with idler rollers as required to maintain a fixed pass line through the throat of the gage. Where a tensiometer is also used between the last stand and the winding reel it can serve as a fixed roller since its movement is negligible. The pass line through the gage need not be horizontal but the angle between the strip and the vertical X-ray beam must remain constant.

A sketch of cold mill gages now being built is shown in Figure 4. Whereas the top detector of the hot mill gage can best be supported separately from the tank in most cases, the cold mill gage is provided with a tank-mounted arm to support the top detector in a fixed position with respect to the X-ray beam. The throat opening of the gage is approximately four inches and depth of the throat can be 30 in. or more to permit measurement near the center of the strip. The width of the gage, measured lengthwise of the strip, has been kept low since available space is usually limited in this direction. Distilled cooling water or antifreeze solution is recirculated between tank, top detector and cooler on remotely located flow panel.

Figure 3 — The thickness gage is usually located between the last stand and winding reel.



SAFETY PRECAUTIONS

Cumulative exposure to X-radiation can be harmful to personnel. It is essential for the power supply to the X-ray tube to be adequately interlocked with safety switches to insure that the gage be turned off automatically when operators approach an area within which they could be burned by the measuring beam.

The top detector of the present 100 kv hot mill gage is inaccessible except through safety gates. The high voltage is removed automatically when a safety gate is opened or when the swing arm supporting the top detector is pushed out of position. Power can be restored only after gages are closed and the arm is in position, and only by the gage operator.

The energy in the measuring beam is low compared with that of many X-ray machines used in medical work. It is improbable that radiation of dangerous intensity will be found at a distance of more than three feet from the vertical axis of the beam or at higher than fifteen feet above the tank with top detector out of position.

It is unlikely that 50 kv gages with four inch throat opening will emit radiation of dangerous intensity beyond the area of the throat itself. A track-type limit switch will be used to remove the high voltage automatically when the gage is pulled off the strip. The high voltage supply can also be interlocked with the mill control if desired, so that the X-ray tube cannot be energized unless the mill is running.

Before initial operation of X-ray gages, it is recommended that a radiation survey be made by a competent radiation physicist to obtain positive evidence that no harmful radiation is present in the operating area.

INSTALLATION

Operating experience with the first hot mill gage has shown the desirability of mounting the tank and top detector on a common truck as shown in Figure 5. Users are making plans to install a number of gages now being built in this manner. The truck is preferably supported resiliently to minimize vibration transmitted to the tank and top detector. With this arrangement the top detector is always in the correct operating position, so that operating conditions can be duplicated during servicing, remote from the mill. All tests and maintenance becomes independent of mill crane facilities.

By extending the track into either the mill motor room or a servicing room built for the purpose, an X-ray tube can be changed under clean conditions. It is important not to contaminate the oil as its dielectric strength is impaired by dirt or moisture, even in small quantities.

Users can provide a track-mounted truck with motor drive if desired to occasionally traverse from the center of the strip to one side, or across the full width if preferred, to check roll shape. In order that the apron plate may shield the top of the tank from as much

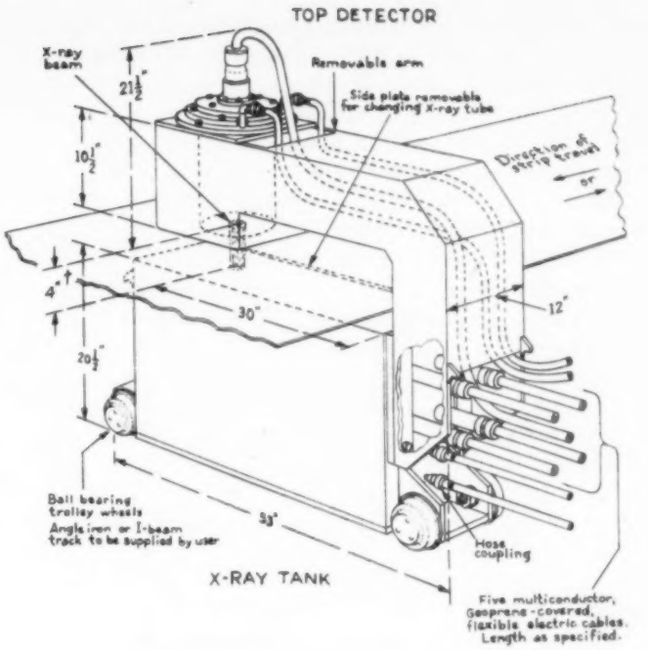


Figure 4 — The 4 in. throat opening may be adjusted to 6 or 8 in. with recalibration.

radiated heat as possible, the slit for the X-ray beam should not be more than two inches wide.

Servicing—As with other electronic equipment containing a number of tubes, a system of preventive maintenance is desirable. This includes periodic measurements of voltages at various points in the control circuit to check adjustments and overall circuit performance, and periodic measurements of tube emissions to anticipate tube failures. Periodic replacement of all tubes is not considered practical as the highest rate of failure of a quantity of tubes is likely to occur during the first few hundred hours of operation. To minimize tube failures, circuits have been designed to use long life tubes wherever possible. Commercial tubes with shorter life expectancy may be used temporarily, in emergency.

Range—For good sensitivity and readability, it is desirable to have the range of the gage no greater than necessary. A range of 0.005 to 0.025 in. (alternatively 0.008 to 0.040 in.) is practical for a 50 kv gage for cold strip mill service. The range 0.040 to 0.190 in. is most popular for the 100 kv hot mill gage.

Alloys—Where alloy steels as well as carbon steels are to be measured, the required gage indicator position for a given thickness and the swing of the deviation indicator pointer for a given change in thickness are different. A second concentric scale of each instrument, marked in dimensionless units, plus a conversion chart for each material, provides a simple solution where a number of alloys having different absorption characteristics are to be measured. Although simple, this is only one of several possible solutions. A multiplicity of scales or a multiplicity of instruments may be considered alternatively.

The problem is best illustrated by Figure 6, showing apparent thickness versus actual thickness for several alloys of aluminum. Alloying metals, having much higher absorption than the parent metal, increase the

total absorption, causing the aluminum alloy to appear thicker than an equal thickness of pure aluminum.

ADVANTAGES

With the advent of the X-ray gage and its guaranteed accuracy of plus or minus 2 per cent, it is interesting to note how the number of units of length obtained from a given size of slab is increased when the X-ray gage is used. Take for instance a product which is nominally 0.070 in. thick and a tolerance of plus or minus 10 per cent, which permits acceptance of strip between 0.063 and 0.077 in. thick. Assuming the lower limit of tolerance to be still acceptable and assuming a variation in thickness of 0.003 in. along the strip, the new tolerance when using the X-ray gauge would be 0.063 to 0.0686 in., nominal thickness 0.0658 in. The increase in available strip length is in the ratio of 0.070 to 0.0658; that is, where we obtained 100 units of length before, we now obtain 106 units, a substantial increase.

Reduction in the amount of off-gage strip means fewer shipping delays and lower production costs. Orders need not be held for completion while another slab of suitable grade is located, heated, and brought through at extra expense.

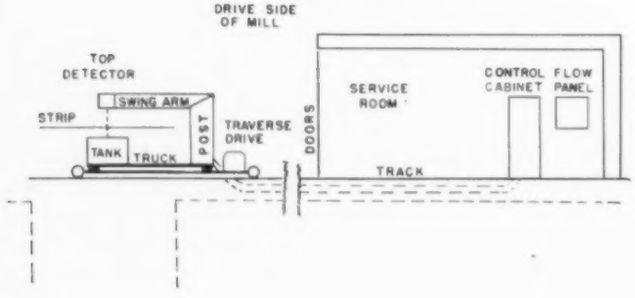
An occasional check of roll shape, using a traversing arrangement, enables the mill to maintain nearly uniform thickness across the strip. This increases the usability of wide strip which is to be slit into narrower bands where uniform thickness of the narrow bands is important.

Progressive cooling during rolling of a hot slab without change in screwdown adjustments results in some taper in the finished strip, the strip being progressively thicker from head end to tail end. X-ray gaging permits adjustments to be made to maintain practically uniform thickness throughout the length of the strip. This reduces the number of adjustments necessary during subsequent cold rolling, which helps to increase cold strip production, and reduce off-gage cold rolled strip. This can be especially important where strip is cold rolled in high speed tandem mills.

Highly accurate cold rolled strip, made possible by X-ray gaging on both hot and cold mills, reduces problems in subsequent processing, as, for example, on continuous electrolytic tinning lines where variations in thickness can affect temperature.

Highly accurate cold rolled strip reduces die wear and other fabrication costs for the ultimate user. Strip held to minimum tolerances provides maximum surface area per ton.

Figure 5 — Tank and top detector should be mounted on a common truck.



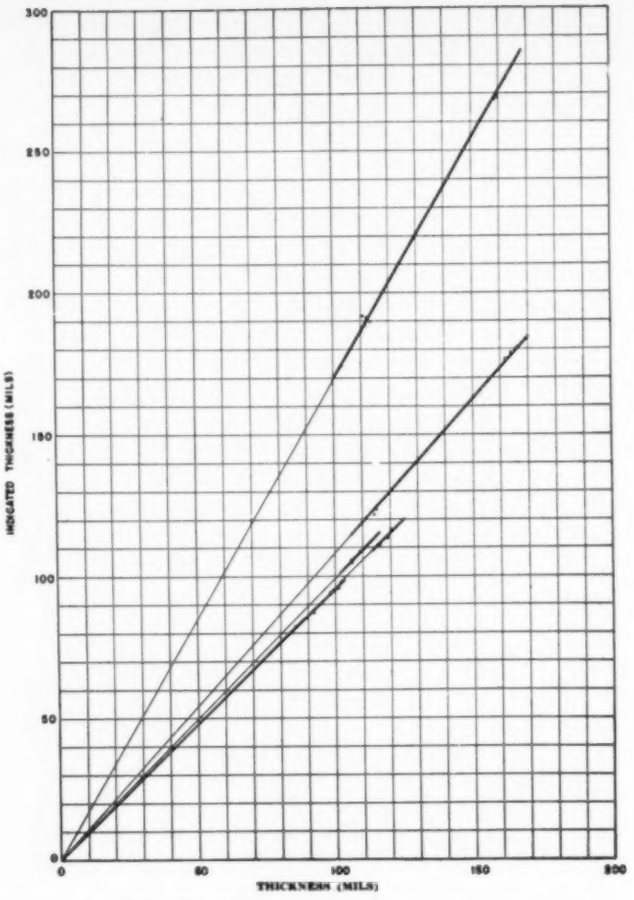


Figure 6 — Alloying elements in the strip may affect the gage calibration.

DISCUSSION

PRESENTED BY

G. E. STOLTZ, Consulting Engineer, Westinghouse Electric Corp., E. Pittsburgh, Pa.

C. W. CLAPP, General Electric Company, Schenectady, N. Y.

A. L. NIELSEN, Chief Engineer, Thomas Steel Company, Warren, Ohio

C. L. McGRANAHAN, Assistant General Superintendent, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

H. S. MAXWELL, General Electric Company, Schenectady, N. Y.

G. E. Stoltz: We are in the early stages of applying X-ray gages to measure the thickness of steel strip and believe that the X-ray gage has sufficient advantages to justify its use on a number of applications. It will be useful on a hot mill to not only indicate the thickness of the strip produced but also to correct the taper from the leading to the trailing end. On one application, the accuracy of the gage was demonstrated when it was found strip was being rolled with periodic variation in

thickness giving it a wave form. Another X-ray gage installed on a processing line indicated the thickness of the strip only and substantially neglected the thickness of the lacquer on the metal. This is as would be expected but having used mechanical gages previously it came as a surprise to the operator.

Member: Assume the gage set up to the center of the two wedges, and we alter the thickness of the strip, am I correct in assuming that the wedge automatically moves across the beam to increase or decrease the amount of X-ray? Does that increase and decrease remain almost linear with the change of sheet?

H. S. Maxwell: Yes.

C. W. Clapp: May I just interject a thought here that has no bearing on the particular question, but it may have escaped some of you in the original reading of the paper. In the matter of safety, some of you may be worrying somewhat on that point. The distances given were three feet from the beam in a horizontal direction, and fifteen feet above the head. Those distances apply to an eight hour day. That is, a man could stand outside of that range for an eight-hour day without suffering any harmful effect, eight hours a day for a year on end. The likelihood that a man would be standing there for any appreciable length of time would be small. Furthermore, those distances apply to the hot strip gage, which runs at twice the voltage of the other, so in the case of the cold mill gage the distances would be smaller.

A. L. Nielsen: I would like to ask what effect the surface condition on the strip may have on the accuracy of the thickness measurements?

C. W. Clapp: The condition of the surface, whether it is rough or smooth, affects the reading only as it affects the average thickness. That is, the gage measures the average thickness, it does not measure the thickness at the peaks of surface irregularities as, for instance, a micrometer would. As far as any coating is concerned, you have the same problem that was discussed before. If you have a metal coating on the strip, it will be just as important as the base metal in determining the reading of the gage. If, however, it is an oil film or something of that sort, then you are considerably better off. Oil has approximately the same X-ray absorption as water and, for example, $\frac{1}{16}$ in. of water on a hot strip gage may give you an error not over one per cent in reading. That is, $\frac{1}{16}$ in. of water looks like one mil of steel as far as X-rays are concerned.

C. L. McGranahan: There are a couple of comments on operating problems I would like to offer. Except for one product we do not consider it an advantage to be able to roll to the light side of the gage for the simple reason we are paid by the pound, and the lighter we roll, the longer time it is in the mill. When it comes to cold rolling, I have had the privilege of watching the author's gage operate, and it does a marvelous job.

On the hot mill rolling operation I would like the speaker to tell me what has been the percentage of outage of the gage over the last six months. I realize that this is a laboratory instrument and we have found that laboratory instruments will not stand rolling mill use and have a large percentage of dependability. Of course, it is only a question of time until a laboratory instrument is ultimately put into production.

It is my understanding that considerable trouble has resulted from water getting into the connection between the control panel and the transformer in the box, and also it is my impression—which may be wrong—that the life of the tube might be anywhere from nine hundred to fifteen hundred hours. In other words, on normal operation we would expect to get from six weeks to two months life out of the tube.

H. S. Maxwell: On tube life I think we are willing to back up the statement that we expect the average tube life to be upwards of two thousand hours. We have had one tube failure at the eighty-inch hot mill. After we had the tube failure we measured the dielectric strength of the oil and found it was below what we had considered a desirable minimum, so we do not know whether the tube failed of its own volition or whether the reduction in dielectric strength caused it to fail.

We do not have a lot of gages to point to and claim that we have an average tube life of a certain amount, but we obtain these tubes through our X-ray company and, putting their experience plus ours in the picture, we think two thousand hours is something that you can count on. We think, on the other hand, that seven or eight thousand hours will probably be the absolute maximum.

With regard to percentage on time and percentage down-time, I do not have any exact figures at the moment, but I think you will find that our operating time within the last few weeks has been about one hundred per cent.

This first gage was a laboratory device; it was placed in the steel mill to see what would happen. Electrically it has exceeded our expectations. Mechanically, the first gage is still somewhat of a laboratory device. We have been wondering whether to give the customer a new one or try to fix up the old one, mechanically, but there is no reason to hide the fact that we have had plenty of growing pains and have been down a good portion of the time. Quite a number of the down-time instances have been due to the nature of the installation and carelessness.

We also made a rather obvious error, looking back, in having a good passage for ventilation in the top detector through the flexible metal hose which carries the electric cables, and we obtained a breathing action through them which put fog in the top detector. A limited amount can be tolerated, but we had enough to cause us some trouble.

We also had a little trouble mechanically with our deviation wedge drive, but all of these things are being carefully noted. We have quite a large number of hot mill gages on order already, and talking in terms of the gages that are being built, we think that our mechanical troubles are going to be relatively minor. We may still have some growing pains because these are new devices, but we learn by experience and we are doing the best we can to incorporate most everything that looks good.

As long as we know that we have a good electrical circuit, and that our stability is what it should be, dependability will follow with the improvements in the mechanical design.

Mechanical in the

. . . . this mechanical repair method will repair large castings without disassembly, shrinkage fractures or warpage . . . .

▲ COLD mechanical repairs were formally introduced in the steel industry at the Buffalo District Section meeting of AISE in April, 1946. Since that time this type of mechanical repair has been generally accepted in the steel industry and has proven to be a most economical and expeditious method of restoring wrecked machinery. Although cold mechanical repairs have passed through a stage of development and were used successfully on industrial and marine equipment for the past twelve years, the process has found new application on heavy steel mill equipment.

For the benefit of those who are not familiar with the difficulties encountered in fusion welding or brazing of large machine sections it may be desirable to justify the development of the mechanical cold working process. It is generally known that the tensile strength of all common metals is enhanced by cold working and it is frequently desirable to induce compressive stresses in a surface normally subject to high tensile stress. This fact is demonstrated by the improved fatigue resistance in shafting after shot peening or cold rolling the surface. Also, the technique of sealing against pressure by caulking of ductile metals has been known as an emergency expedient for many years. It was with this fundamental knowledge that these techniques were combined to form the basis of mechanical repair.

PROPERTIES OF CAST IRON

A brief review of physical properties of the common materials of construction, and the practical considerations in repairing large machine sections, will suggest the need for the type of repair discussed in this paper. Although the mechanical repair was developed principally for cast iron sections it should be emphasized that it may be applied economically to any type of ferrous or nonferrous metal. The physical form, size and location of the fractured section frequently is the determining factor when considering the most desirable method of repair. Since most large machinery is constructed of cast iron and it is one of the most difficult materials to weld we will discuss its merits as a material of construction.

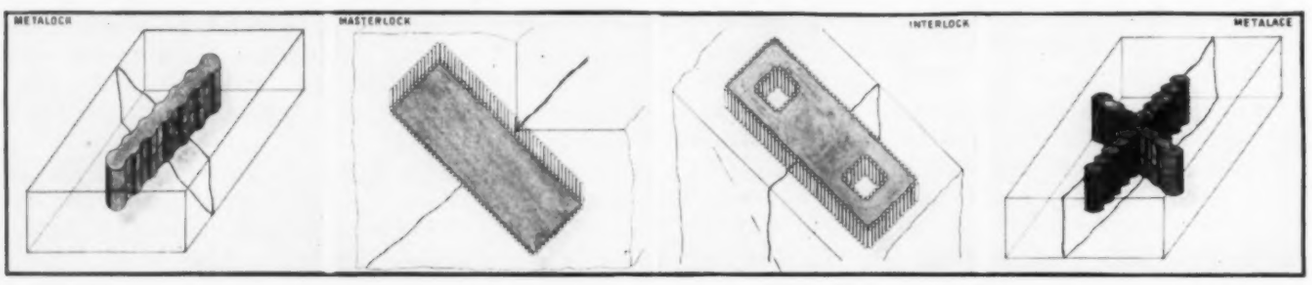
Cast iron is one of the most difficult materials to repair or fabricate but is also one of the most common and actually one of the most desirable of materials for building large machine sections. The modern alloy cast irons offer a wide range of physical and chemical properties which are hard to match with any of the common materials used in construction of heavy machinery. Foundrymen are well aware of the advantages of cast iron over steel when considering the possibilities of obtaining sound, homogenous sections throughout the casting. Even with the most advanced foundry technique it is often difficult to produce steel castings free from blow holes, porous and imperfect sections which are frequently the source of eventual failure.

We are all familiar with the development of high strength cast irons which compare favorably with commercial grades of steel casting materials. Cast iron possesses excellent damping properties and is not as susceptible to notch sensitivity as many comparable materials. Therefore, cast iron may be used to advantage where failure would be expected from repeated stresses through incipient fractures. Use of alloy cast iron in crankshafts of modern engines is substantial proof of its acceptance as a desirable material in modern engine design. These suggestions are made to indicate that the trend in modern machine design is to encourage use of the improved cast iron alloys rather than complete conversion to cast steel or fabricated sections.

In the repair of any casting or weldments by fusion methods the problem of shrinkage of the weld metal is difficult to overcome. This shrinkage invariably results in harmful residual stresses, warpage, and frequently in failure in the repaired sections while the weld is cool-

Presented before AISE Annual Convention, Cleveland, Ohio, September 29, 1948

Figure 1 — Four different types of locks are used depending on the application.



Insert Repairs Steel Industry

By R. L. RECTENWALD
Chief Engineer
Metalock Corporation of Pa.
Pittsburgh, Pa.

ing. It is true that preheating and normalizing after welding relieves some residual stress, but to do this properly, the machine must be disassembled and heat treated uniformly throughout the entire unit. It is impossible to make a weld of any kind without subsequent shrinkage, and in restrained sections where there is no compensation for the shrinkage, the weld is a very unsatisfactory method of repair. The economical aspects are immediately apparent when we consider dismantling some of the large equipment such as large compressors, diesel and steam engines and heavy steel mill equipment. Loss of production also is an item which may far outweigh all other costs on such a project.

DESCRIPTION OF METHODS

The foregoing discussion attempts to justify and predict the continued use of iron castings in production of heavy machinery and suggests a few of the difficulties which may be experienced in attempting repairs of any machine elements by fusion welding. We now wish to introduce metal insert repairs as a supplement to welding in fabrication and repair of heavy machinery.

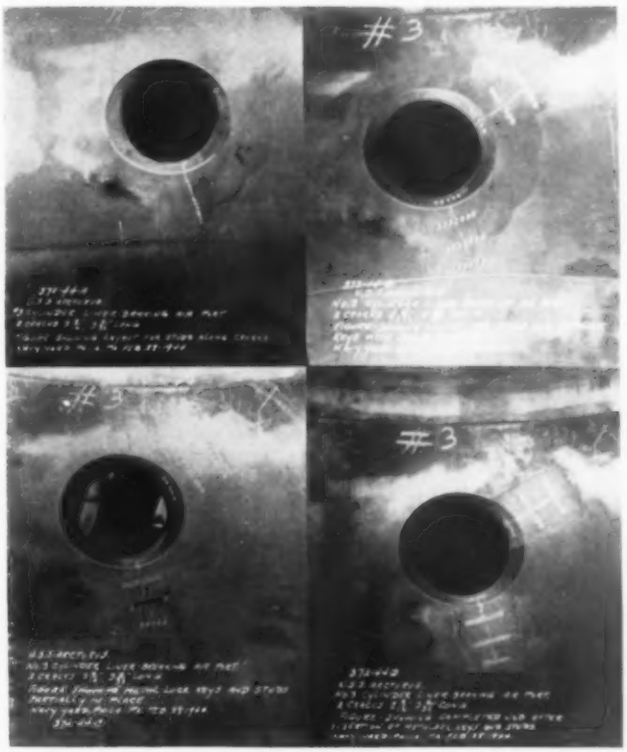
Figure 1 is a graphic illustration of the various steps in accomplishing the cold mechanical repair. The first drawing of the group represents a set of two metalocks imbedded across a fracture. The last drawing depicts the Metalocks with the studs used for caulking and preloading. The "Masterlock" and "Interlock" are variations of the repair which will be discussed later.

The basic lock consists of a forged bar of high strength alloy which is crimped at regular intervals so that it has the appearance of a number of cylinders joined by straight sections of uniform length. The cylindrical sections are commonly called "lugs" and the shear resistance or holding strength depends upon the number of "lugs" anchored on each side of the fracture. The locks are installed in slots across the fracture to a depth of 75 to 90 per cent through the section. The slots are prepared by drilling a series of holes equal to the number of lugs on the lock used. The holes are accurately spaced with a drilling template which is designed to leave a web about ¼ the diameter of the hole between the holes. The web is then removed by cutting between holes with special pneumatic tools. The slots are accurately sized to give a shear fit when the "locks" are driven in. Each lock is upset and swelled into the slot by cold working before the successive locks are driven in to form multiple layers. In a section three inches thick, locks of ¼ to 5/16 in. thick would be used. Depending upon the size used, the number of locks in each slot would probably be from seven to ten, cold worked and swelled one over the other until the slot is full of locks. The spacing of the lock sets in this case would be about 1 to 1¼ in. between centers. The sets of multiple locks are spaced along the fracture in line with the apparent stress.

After all locks have been installed the fracture is filled by lace which is a series of studs or a combination of studs and dowels which are tangent to each other. The lacing is upset much the same as the locks and a continuous line of metal is thus caulked into the fracture, giving a pressure-tight joint and serving also as the means to preload the locks in tension. This preloading of the locks is a very important feature of the repair because it is the means by which we avoid fatigue failure through reversals of stress in the locks. The preloading is also insurance against any looseness in the repaired section. The resulting joint efficiency in cast iron is frequently 100 per cent or better but is reduced in steel inversely as tensile strength increases.

The series of photographs shown in Figure 2 illustrates an actual repair of a large cylinder liner. The first two views show the layout of the repair; the third

Figure 2 — The views show four steps in repairing a cylinder liner for a naval vessel, at upper left is the fracture layout, at the upper right the lock pattern is laid out perpendicular to the fracture, at lower left some locks and lacing are in place, and at the lower right is shown the complete repair before honing the cylinder.



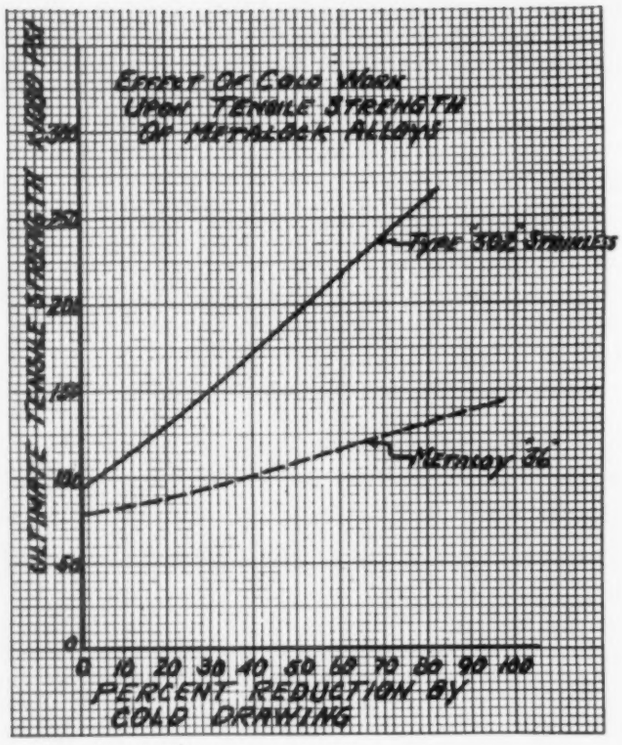
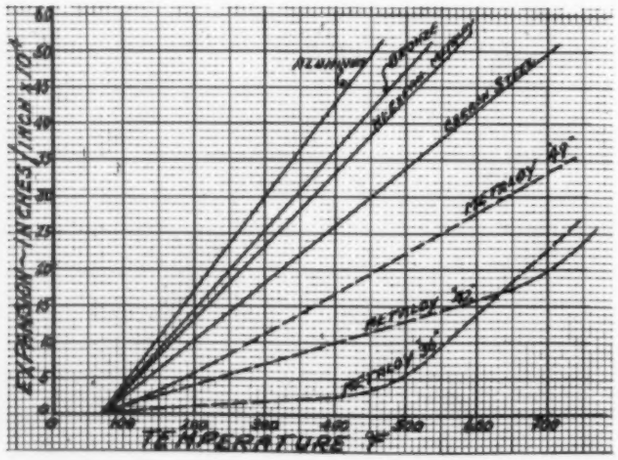


Figure 3 — Effect of cold work on tensile strength of material used in locks.

shows two sets of "locks" installed, one slot completed, and a portion of the lacing. The fourth view shows the complete repair before honing.

The alloys from which the locks are produced are high nickel steels ranging from 35 to 60 per cent nickel. This type of steel is very ductile after considerable cold working, which makes it particularly suitable for such repairs. Also, within the range of alloys mentioned, there is a wide range of thermal expansion properties. The low nickel alloy has a very low coefficient of expansion (about $\frac{1}{10}$ that of mild steel) and the high nickel alloy expands at about twice the rate of mild steel in a given temperature range. In applications subject to high temperatures the low expansion alloy would be used to take advantage of the expansion of the parent metal in preloading the joint.

Figure 4 — Average expansion rates of material used in locks.



THERMAL EXPANSION

The low nickel alloy has a break point in the expansion curve at about 400 F, at which temperature the expansion proceeds at about the same rate as mild steel. The high nickel alloy would conversely be used on low temperature applications such as liquefaction equipment. This material develops exceedingly high physical properties when cold worked. The limiting factor in obtaining high strength in the locks is the ductility which the alloy possesses throughout the process of cold working. A good example of this combination of properties is found in the austenitic alloys such as the common 18-8 variety of stainless steel. We find that this material work hardens so rapidly that the maximum strength and hardness are attained before the locks can be properly imbedded into the parent metal. Figures 3 and 4 show the cold working properties and thermal expansion properties respectively, of some of the alloys used in such repairs.

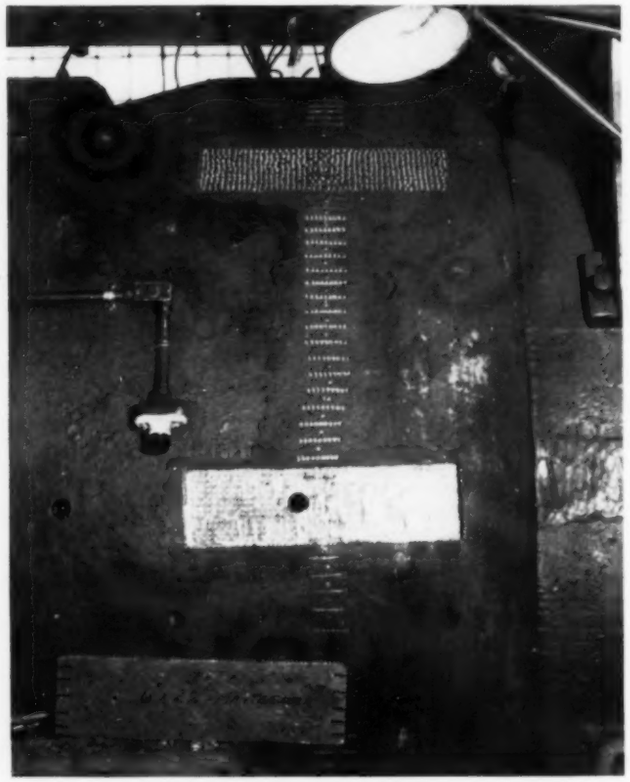


Figure 5 — A master lock was used in repairing the flange section of a large blowing engine frame.

STRESS DISTRIBUTION

Another phase worthy of discussion in the master lock which is an inlay of alloy steel used as reinforcement when regular locks alone would not be sufficient. These are large slabs of steel which vary in size and

shape to suit field conditions and may be several feet in length in extreme cases. This lock is formed by cutting half holes around the perimeter of a flat plate, leaving a small web between the holes. The half holes in the master lock are laid out to match half holes in the casting. A recess is cut within the boundary of holes to receive the lock. When installed the holes between parent metal and the lock are reamed to form perfect holes of the matching half holes. This lock is usually set in the casting so that its exposed surface will be flush with the original surface of the parent metal although in some cases this is not desirable. The lock is secured in the recess by upsetting short dowels into the reamed holes so that each hole is completely filled with short pins upset and expanded to give a firm body-bound fit in each hole. These locks are usually designed to have at least twice the shear strength around the perimeter as tensile strength through the transverse section. A master lock is frequently used to dissipate the high local stress across the corners of bearing chucks of engine frames. Where a fracture occurs through a weak section between internal ribs or between heavier sections this lock is often used to reinforce across the weak section and is anchored in stronger sections at the ends. Mild steel plates in the form of such locks are sometimes imbedded in iron castings in order that other members can be welded to them, thus combining a casting with a weldment. It is also common practice to secure bosses, ribs, guides and other appendages to large iron castings in this manner. Another application has been inlaying sections of stainless steel to resist local cavitation in hydraulic equipment. Many other applications of this lock have been put to practical use on all types of equipment.

TYPICAL REPAIRS

A few of the notable repairs made in the steel industry and associated heavy industries are shown in the accompanying photographs. Figure 5 shows a close-up of a repair under way. The large horizontal gas engine has a circumferential fracture around the cylinder flange of the main frame. In this case it appeared to be advisable to reinforce the frame by use of master locks anchored between the internal circumferential ribs. In this manner additional strength was obtained by connecting two heavier sections adjacent to the weaker path of the fracture. The repair, when completed, would be stronger than the original section. Such failures frequently occur as a result of foundation settlement, water in cylinders or fouling of working parts. The fracture would occur at the weakest section and often may start through a main girder of the frame, bearing chuck, or in the crosshead section.

Figure 6 shows an upsetting machine frame which was fractured across the top of the girder. The original failure was repaired by welding as can be seen in the photograph. The frame failed in the heat affected zone adjacent to the weld after about one week's operation. Due to the wide area of the weld and the doubtful condition of the parent metal in this section, it was necessary to use master locks with the regular locks in order to obtain the necessary restoration of strength.

Figure 6 — The metal insert method gave a satisfactory repair on the upsetting machine after a welding repair was found to be unsatisfactory.

Figures 7 and 8 show a 10,000 kw steam turbine casing which was wrecked as a result of an internal explosion due to accumulation of hydrogen after acid cleaning the condensers. The exhaust end of the casing was fractured circumferentially and some pieces were too badly shattered to replace. New sections were cast to replace the missing pieces and inlayed with the original pieces to complete the repair. This repair was required to pass underwriters' inspection. The time required to complete the work was between three and four weeks as compared with 12 to 18 months required for replacement. Similar repairs have been made to the high pressure end of steam turbines and to large turbo blower casings.

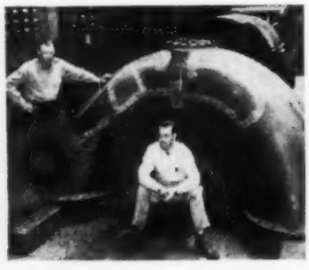
The photograph, Figure 9, shows a small Corliss steam cylinder with a large section of the steam chest broken out. This failure is one of many similar repairs which have been made on Corliss cylinders ranging from 24 in. to about 80 in. diameter. Fractures frequently start in the steam ports of a cylinder and extend through the main flange, valve flanges, valve seats or through the cylinder wall. In the case of the larger cylinders the work is usually done without dismantling the engine other than to make the fracture accessible. On vertical engines it is often possible to repair a fractured cylinder or head by raising the head sufficiently to allow a man to work inside the cylinder. This operation has saved weeks of outage time where dismantling is a major project.

Other types of steel mill equipment which have been successfully repaired include bar shears; upsetter frames, flywheels and crankshafts; flywheels; crossheads; blowing engine air cylinders; bed plates; gear cases, and large gears. Since each job requires somewhat different techniques it is always necessary to study each application with operating conditions in order to properly evaluate the repair.

THE SURVEY

The survey of a prospective lock repair is of utmost importance. The success or failure of a repair depends largely upon the judgment and experience of the person who surveys the equipment and lays out the repair. In making such a survey, we first try to establish the cause of failure and to determine how this source of trouble can be eliminated. If the cause and correction cannot be satisfied the repair will usually be abandoned. If the cause of failure is found to be misalignment of moving parts, worn bearings, defective material, accidental failure or other faults which can be corrected, the repair is laid out and an estimate made of the original strength as compared to the repaired strength. The strength and physical condition of the parent metal is appraised. If the equipment is subject to corrosion it is necessary to study the effect of corrosion and galvanic action. On all temperature applications it is necessary to judge the effect of temperature upon the repair and compensate for undesirable temperature effects. In all cases a fair estimate should be made of the direction of principal stresses if not the magnitude of stress. After all of these points are considered our proposal is submitted and the work is performed as laid out. Many jobs are rejected when we recognize conditions which would obviate a permanent repair and would not meet underwriters' requirements. It is our policy to make no repairs which we cannot guarantee; however, emergency repairs are made in remote cases to enable operation until replacements can be made.

Figure 7 — On left is shown a 10,000 kw steam turbine casing wrecked by an internal explosion, and on the right is shown the same casing after being repaired.



FIELD INSPECTIONS

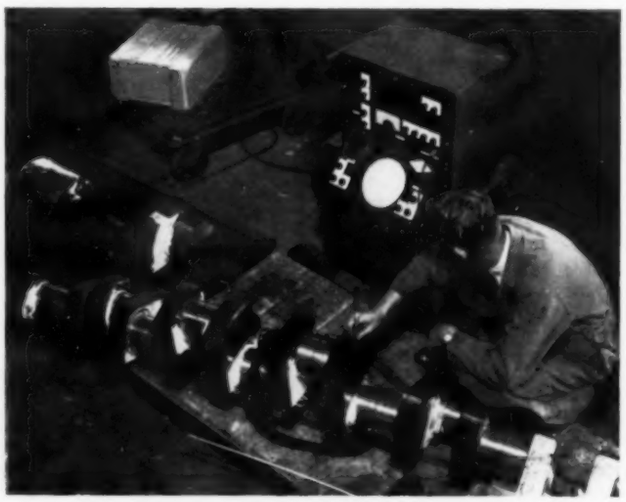
The problem of locating and identifying fractures sometimes requires considerable skill, particularly if inspection cannot be made while the equipment is operating. We employ all recognized methods of determining the existence, extent and depth of fractures. Perhaps the most common method is use of a chalk and alcohol solution applied after the questionable section has been soaked with penetrating oil and dried. Magnaflux and zyglow are also used to check surface fractures. The reflectoscope has been used to great advantage in determining the depth and direction of fractures below the surface and for locating fractures under flywheel seats, crankshaft webs and in other hidden sections.

Figure 8 — Repairs on steam chests are easily made.

Figure 10 shows a crankshaft being inspected by the reflectoscope before attempting a repair. This shaft had previously been checked by the whiting method and by magnaflux. Three fractures were located in addition to the total failure through the crank web shown. The presence of the fractures was confirmed by all three tests and the depth of the fractures were shown only by the reflectoscope. This crankshaft was scrapped as a result of our preliminary tests since such extensive repairs or future maintenance of the equipment. We have quently been made on large crankshafts and other equipment which often uncover facts having considerable bearing upon the action to be taken regarding repairs or future maintenance of the equipment. We have encountered numerous occasions where use of such a testing procedure as a part of routine preventive maintenance would have forestalled serious accidents.

Our program for future development and research includes studies of new materials and methods. We are

Figure 9 — A crankshaft is being checked by the reflectoscope to determine location and extent of cracks.



planning field tests and laboratory tests using stress coat and electronic strain gages to provide an accurate analysis of repairs under actual operating conditions. We would welcome the opportunity to participate in experimental work in any field where lock repairs have not been tested previously.

DISCUSSION

PRESENTED BY

F. ECKHARDT, Chief Engineer, Bethlehem Steel Co., Lackawanna, N. Y.

E. W. TREXLER, Supt. Mechanical Department, Bethlehem Steel Co., Johnstown, Pa.

F. Eckhardt: You maintenance men seem to have the answers to all of your problems. As Mr. Rectenwald told you, lock repairs came to our attention in Buffalo some years ago at one of the district meetings. Our maintenance man came to me and said, "That is just the thing I need. We have two blowing engines with cracked beds and cracked cylinders and a few other things that are cracked."

Since that time we have completed, at the Lackawanna plant of Bethlehem Steel Company some thirteen major repairs. The total costs of these repairs are in excess of $40,000. Out of curiosity the other day we looked up the castings and made a quick guess as to what they might have cost if we had replaced them and we found out it was considerably in excess of a quarter of a million dollars.

E. W. Trexler: We repaired by the lock method a broken crankshaft on our slab mill vertical roll engine. This shaft is 16 in. in diameter at the main journal, and the break occurred adjacent to the crank, at which point its dimensions are 7¾ x 17 in. The repaired shaft was in service six months and the lock then became loose and the shaft was replaced, but we were able to run until a spare shaft was ready.

Plan to attend . . . .

ANNUAL CONVENTION

ASSOCIATION OF IRON AND STEEL ENGINEERS

PITTSBURGH, PENNSYLVANIA

HOTEL WILLIAM PENN

OCTOBER 3, 4, 5 AND 6, 1949

RUST PREVENTIVES HELP

. . . . petroleum base coatings are particularly effective in preventing corrosion because they are relatively waterproof, and stick to and with the metal which is to be protected . . . .

▲ CONSIDERABLE emphasis has been placed on corrosion in general industry. Papers dealing with various corrosion problems occur frequently in technical publications. It is not the intention of the author to discuss in this paper the various theories of corrosion or the extent of corrosion existing in industry. It is the purpose of this paper to point out some applications of coatings which have found general acceptance by industry for the protection of valuable steel structures.

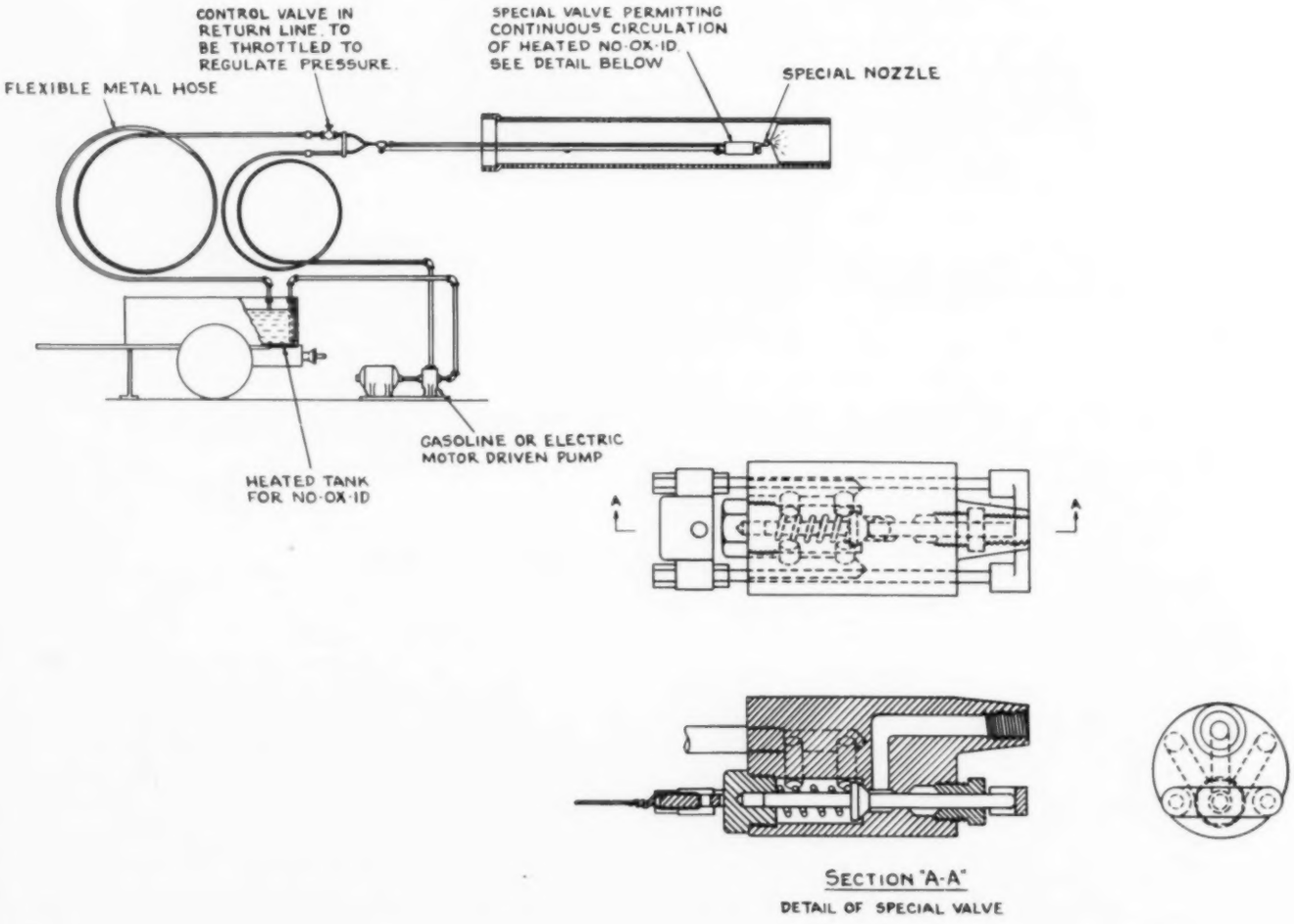
These coatings which will be discussed are basically of petroleum origin, and are non-drying in nature. They function successfully because of their inherent properties of high waterproofness, flexibility, elasticity, and ability to wet the metal and stay with it as it contracts and expands under extremes of temperature conditions. These petroleum base coatings will hereafter be referred to as rust preventives.

Although rust preventives may vary from light consistency oils to heavy waxes, we will only discuss the heavier grease types or wax types which are used mainly for maintenance coatings on steel structures. These coatings have no decorative value whatsoever, and are used solely in applications where appearance is of no importance. The only requirement of these coatings is that they perform effectively and protect that particular structure to which they are applied, under a set of conditions which would tend to deprive it of its usefulness by corrosion.

The basic ingredients of these materials are refined products, some of them being capable of lubricating finished steel surfaces and at the same time offering

Presented before AISE Annual Convention, Cleveland, Ohio, October 1, 1948

Figure 1 — Illustrated in the photograph is a spray system for applying waxes while hot.


CONTROL VALVE IN RETURN LINE TO BE THROTTLED TO REGULATE PRESSURE.
SPECIAL VALVE PERMITTING CONTINUOUS CIRCULATION OF HEATED NO-OX-ID SEE DETAIL BELOW
SPECIAL NOZZLE
FLEXIBLE METAL HOSE
GASOLINE OR ELECTRIC MOTOR DRIVEN PUMP
HEATED TANK FOR NO-OX-ID
A
A
SECTION "A-A"
DETAIL OF SPECIAL VALVE

MAINTAIN STEEL STRUCTURES

By J. G. SURCHEK
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protection from corrosion. The refined bases usually are petrolatums, of both low and high melting points, in combination with oils and in some instances resins and pigments. These materials are blended into coatings of certain hardness and melting point, depending on the end use of each product.

These bases when applied give considerable mechanical protection, that is, they prevent the water and water vapor from reaching the metal surface. In discussing organic films we know that waterproofness is a relative thing. Even though we provide a film of high mechanical strength which is relatively continuous, we realize that eventually moisture vapor or water does penetrate the film. To take care of this moisture, small amounts of chemical inhibitors are added, which to a large degree are responsible for the excellent performance of these materials.

These inhibitors function in several ways. They may be alkaline in nature and of slight water solubility, which would tend to buffer the pH of any water that succeeded in penetrating the protective coating, and to maintain it in a range where the solution would form a thin protective film on the underlying metal surface. These inhibitors might also be a material which combines with any oxygen dissolved in the water entering the film, permitting polarization to develop. It might be a salt which dissolves in the water absorbed in the coating. As this solution is carried to the metal surface, it can react with the base metal to form a relatively impervious, thin, oxide or phosphate film.

A common type of inhibitor is the polar type. It is an organic compound which tends to concentrate in the coating-metal interface. The inhibitor in the interface is absorbed on the metal surface, forming a continuous protective film. Through their affinity for metal surfaces, these materials prevent water from contacting the metal surface. Thus, we find that in the rust preventive we have a base offering certain mechanical protection, plus a small amount of an additive which neutralizes the effect of water or any electrolytes when and if they penetrate the protective film.

Generally speaking, the rust preventive films we are concerned with for maintenance purposes vary from the grease types to waxes. Both of these types have high wetting power, and wet the surface thoroughly. They are very elastic and flexible, and stay with the metal even when it is disturbed or as it expands and contracts with temperature changes. Because of the high waterproofness, they have excellent dielectric strength, and also have insulating properties. It is a combination of these properties that make these materials effective on structures in contact with water, weather, or corrosive atmospheres.

Before discussing specific uses, however, we might add that up to a short time ago the use of the heavy wax-type materials was somewhat limited in application. Unlike the soft waxy types which can be applied by brush, these materials are relatively hard and firm, and must be reduced to a liquid state by heat before they can be used. The only methods by which they could be applied were by hot dip methods or flow coating, as is the case in applying the material to steel pipe. Our company was instrumental in developing a method of application which makes it possible to spray these hot waxes. Thus, it becomes possible to apply these highly waterproof waxes to flat metal surfaces, and even inaccessible places such as the interior of water pipes.

In this method the waxy materials are applied hot. Their melting points vary between temperatures of 140-170 F. Having very sharp melting points, they set up very quickly when they are cooled. Any system that would handle these materials must of necessity, therefore, have a constant circulating system which would prevent the material from setting up in the lines. Essentially, the spray system is as shown in Figure 1. The hot material is circulated in a double pipe system to a special spray nozzle. Pressure and circulation are maintained by means of a rotary pump which will create pressures up to 400 psi at a maximum of 350 F For general application work, the temperature of the material is kept between the range of 250-350 F. When the material is sprayed, line pressure is regulated by means of a valve in the return line. By adjusting the valve in the return line, any desired pressure can be obtained. Usually, flexible metal hose is used on the feed and return lines for flexibility.

The valve to which the hot material is fed is designed to open by remote control. A special spray nozzle is attached to this valve. When the material is being sprayed, it is bled off from the main circulation system

Figure 2 — A combination of a waxy coating and wrapper applied mechanically gives economical protection to pipe lines.

and issues from the spray nozzle virtually as a sheet of liquid. The molten material impinges on the surface with considerable force. The coating applied by this method is usually in the neighborhood of $\frac{1}{32}$ in., which is the required thickness for this material. As it hits the surface it solidifies in place. After the material is solidified, small sag marks and pinholes which may appear in the coating are smoothed out by means of a suitable torch.

The spray method has been used in the lining of steel water pipe, using a 360 degree spray nozzle. The same double pipe circulation system is used, except that the special valve and spray nozzle are attached to rigid pipe which is several feet longer than the longest length of pipe that is to be lined. This rigid assembly is pushed through the pipe to the far end. The valve assembly with the 360 degree spray nozzle attached to it is opened by remote control, and the entire assembly is drawn out to the near side of the pipe at a constant rate of speed. A smooth, continuous film of wax is deposited on the periphery of the pipe. This new spray method now makes it possible to line any size water pipe easily and quickly.

Soft waxy types resembling greases can be applied by other high pressure spray systems now commercially available on market. These systems use air, and atomize the material. They are similar to systems used for greasing automobiles. An air pump developing a line pressure five and one-half times greater than the pressure supplied by the compressor forces the material of grease consistency through a high burst hose to a spray head. There the material is atomized in specially designed spray heads. This method of applying the soft waxy material is considerably more rapid than the brush application, and is used where there is a large area to be coated.

So far we have discussed the general types of materials that rust preventives are, and the methods by which they can be applied. Following are several interesting uses of these materials:

Pipe lines — These rust preventive coatings have been used extensively for the protection of underground steel pipe lines. One type of material, which is a pigmented grease type containing solvent for ease of application, is used on small lines and is applied by hand methods. The use of this type of coating eliminates the operation of heating kettles and heavy equipment and provides effective, economical protection. A reinforced fabric wrapper of laminated construction, containing high melting point waxes, is used as a shield over this material, and is applied by spiral hand wrap method. In addition to serving as a shield, the wrapper keeps the rust preventive in intimate contact with the pipe. This combination provides good insulation and corrosion-resistant properties.

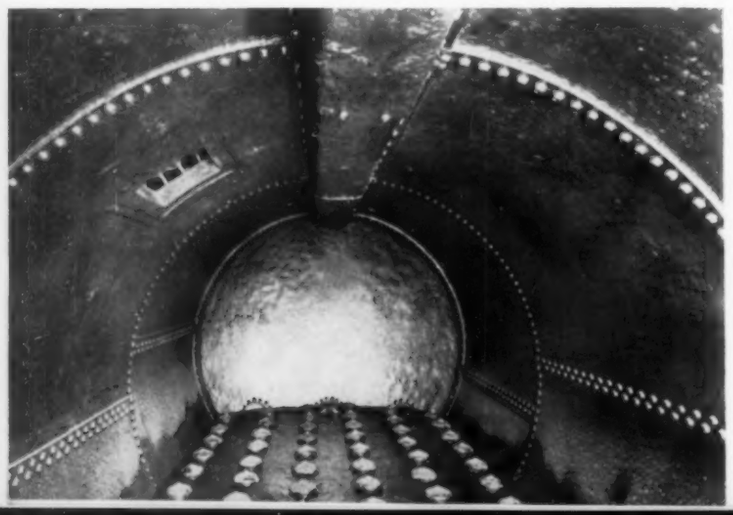
For large lines or large diameter pipe, where the use of mechanical equipment is warranted, the heavier, high melting point waxes are used. These heavy waxes are applied hot to the exterior of the steel pipe by means of coating machines, which may be stationary or may be the type that straddle the pipe for coating in the field. While the wax is still in a molten condition, a reinforced laminated wrapper of high dielectric strength is spirally wound around the pipe, providing a bonded wrap. Through this process the base coating is fully protected with an unbroken shield of a durable wrapper (Figure 2).

Steel water pipe and even cast iron pipe can be lined with those heavy waxy materials to prevent corrosion and subsequent tuberculation, which would tend to cut down the capacity of the pipe. These linings also prevent red water, which is a condition caused by the accumulation of red rust in dead end water systems. The lining is applied by the special hot spray system mentioned previously using a 360 degree spray nozzle.

Water tanks—Both the soft grease coatings and the dense high melting point waxy materials are used for the purpose of coating potable or other water storage tanks. Wherever hand application is desired, the soft

Figure 4 — Two types of coatings are often used for gas holders.

Figure 3 — The spray method is also used in coating the inside of tanks.



grease materials are applied by brush methods. In cases where a more permanent coating is desired, the heavy waxy types are applied by means of the hot spray system mentioned previously. Considerably more precautions must be taken to clean and prepare the surface when applying the heavy waxy types. The metal must be sand or gritblasted to remove all deposits and corrosion. The surface also must be absolutely dry. In the case of the soft greasy types, it is only necessary to wire brush the surface to remove all loose deposits and rust. The advantages of using these rust preventive films are the one-coat application, the ease of application, and the shorter time that the tank is out of service (Figure 3).

Gas holders — The soft waxy type materials are highly effective in protecting multi-lift type or water-type gas holders. These gas holders are subjected to severe corrosion due to natural conditions existing, especially the intermittent immersion of the lifts. Usually the lifts that immerse are coated with the soft waxy type materials. The tank and crown sections are generally coated with a semi-drying type of rust preventive which is dry to the touch (Figure 4).

Railroad equipment—Railroad structures are subject to highly corrosive conditions. The soft grease type materials are very effective for use on railroad bridges (including the expansion bearings on the bridges), turntables, (Figure 5), track signal installations, locomotive springs, and other types of railroad equipment where decorative colors are not important and where the general public does not come in contact with the surfaces. An interesting use is for the lubrication and prevention of corrosion of joint bars on steel rails, which has always been a problem. A soft grease-type rust preventive is used on the joint bars to prevent the freezing of rail joints. In this particular case a material is needed which will provide lubrication as well as rust prevention. If a rail joint freezes through corrosion, expansion of the rail on a hot summer day tears the rail out of alignment. In the winter, the contraction of the metal breaks the bolts in the rail joint.

Another interesting application of a combined rust preventive and sealer is the joint bar filler. There is a space between the joint bar and rail, usually about one inch wide and about two to three inches high, that provides ideal conditions for accelerated corrosion to develop. Dirt, dust, moisture and brine are driven into this space by the rush of air created by traffic passing over the rails. A sealer material has been developed to close up this space and prevent corrosive elements from entering.

Figure 5 — Railroads use the soft grease type materials on a large number of their applications.

Figure 6 — Corrosion is one of the worst problems which must be solved in the maintenance of marine equipment.

Semi-drying pigmented types are used as seam fillers in the construction of railroad cars. These materials are applied during the construction of the cars, and are very effective in stopping corrosion from developing in cracks, seams, and crevices.

Marine equipment — The waxy type rust preventives are used extensively in the marine field. They are effective in protecting equipment from the action of water. They are used for coating barge holds, buoys, rigging of all types, ballast tanks, brine tanks, buoyancy spaces, decking, etc. See Figure 6. In the buoyancy spaces of steel floating equipment, the qualities or characteristics of rust preventives make them ideal coatings for this use. In outside wing compartments, peaks, and rake ends, where both corrosion due to moisture, and hard usage resulting from impact, are considerations, a non-drying rust inhibiting coating stands up year after year. Rust preventives lend themselves particularly well to protecting chains, gears, steel cables, turnbuckles, and bolt threads from rusting, and have the added feature of being lubricants as well. Between steel to steel secured surfaces such as chock or bitt installations they perform as good sealers.

On salt water vessels they find uses in all void spaces, cofferdams, chain lockers, under wood decking, hollow rudders and keels, running and standing rigging, spare tail shafts, tools, and laid up machinery. Interiors of wings and pontoons of steel floating dry docks are coated with these materials, as are similar spaces in caissons and lock gates.

General industrial equipment — Rust preventive coatings are used extensively in general industry wherever protection of steel is required against corrosive atmospheres, weather, and water. Specific uses are too numerous to mention, but can be generally included under operating equipment (both stationary and field equipment), structural steel, piping, tanks, etc.

This discussion has pointed out many significant uses of rust preventive materials as maintenance coatings. Their ease of application, low cost, and extremely long life are reasons for their continuing and increasing use by industry. Because of their excellent performance record, industry is recognizing that these materials should definitely not be overlooked when considering maintenance coatings.

MODERN SEAMLESS TUBE MILLS

By WILLIAM RODDER
Vice President in Charge of Engineering
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Youngstown, Ohio

. . . . the adoption of a number of improvements in the past few years has increased speed, production and quality of the pipe produced on the seamless mill.

▲ THIS paper deals principally with the modernization of component units used in the plug mill type of seamless tube mill, such as the one shown in Figure 1. This type of mill is the most common in use in this country.

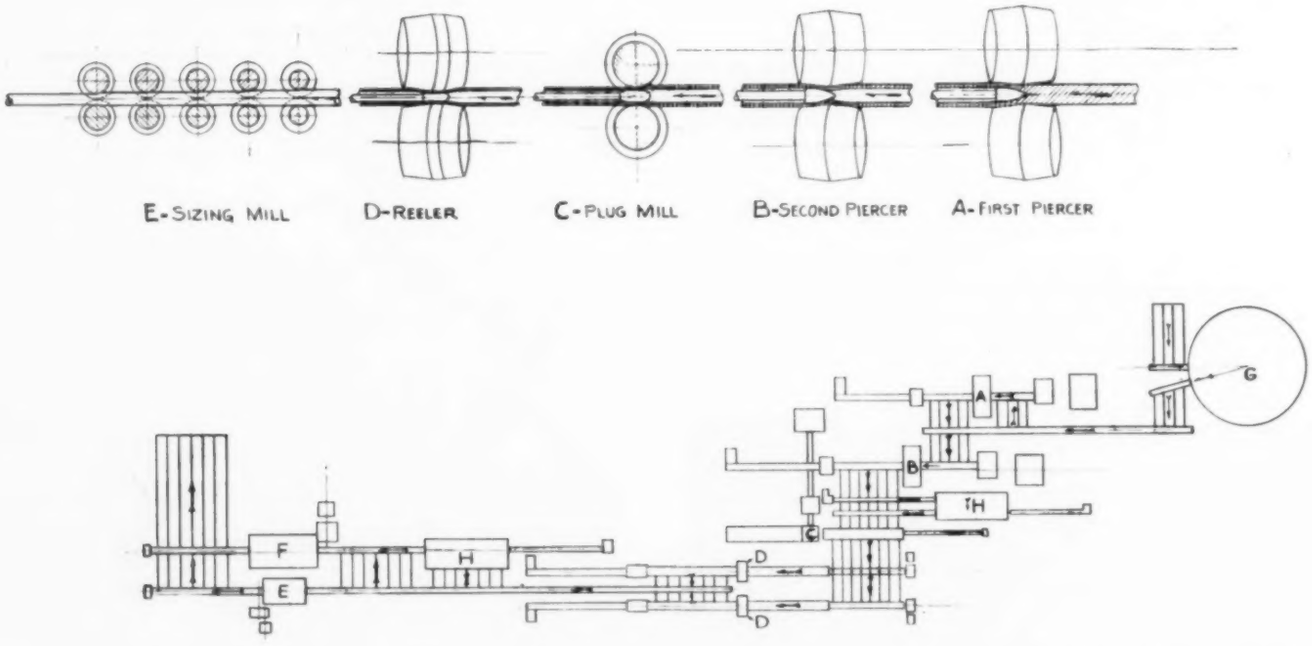
This paper will first briefly describe the process and flow of material and the latter part will point out improvements which have been made in the last few years in the design of the various units.

As shown in Figure 1 the hot mill end of this mill consists of the following main units:

1. Piercing mill No. 1.
2. Piercing mill No. 2.
3. Plug mill, also called automatic mill.
4. Reelers.
5. Sizing mill.
6. Reducing mill.

The following furnaces are also required:

Figure 1 — Diagrammatic layout of a seamless tube plug mill layout.



ITEM	SOLID BILLET			TUBE LEAVING FIRST PIERCING MILL					TUBE LEAVING SECOND PIERCING MILL					TUBE LEAVING PLUG MILL						TUBE LEAVING REELER					TUBE LEAVING SIZING MILL						TUBE LEAVING REDUCING MILL					
NO	DIA., INCH	LENGTH FT.	WT. #	O.D. INCH	I.D. INCH	WALL INCH	WT. PER FT. #	LENGTH FT.	O.D. INCH	I.D. INCH	WALL INCH	WT. PER FT. #	LENGTH FT.	O.D. INCH	I.D. INCH	WALL INCH	WT. PER FT. #	LENGTH FT.	NO. OF PASSES	O.D. INCH	I.D. INCH	WALL INCH	WT. PER FT. #	LENGTH FT.	O.D. INCH	I.D. INCH	WALL INCH	WT. PER FT. #	LENGTH FT.	NO. OF STANDS	O.D. INCH	I.D. INCH	WALL INCH	WT. PER FT. #	LENGTH FT.	NO. OF STANDS
1	2 1/2	5.6	114						3.00	2.50	.250	7.341	15	2.750	2.522	.109	3.014	36.1	2	3.00	2.792	.104	3.217	34.5								1.500	1.204	.148	2.137	52	20
2	3	7.4	172						3.00	2.31	.344	9.758	17.8	2.750	2.375	.187	5.181	34	2	3.00	2.640	.180	5.421	32								1.500	1.000	.250	3.338	52	20
3	3	6.5	157						3.25	2.68	.281	8.918	17	3.125	2.897	.114	3.681	41.3	2	3.375	3.157	.109	3.802	40								2.000	1.704	.148	2.917	52	20
4	3 1/2	8.9	250						3.50	2.812	.344	11.59	21	3.250	2.862	.194	6.340	38.5	2	3.500	3.125	.187	6.689	36.9								2.000	1.500	.250	4.678	52	20
5	3 1/2	8.8	248						3.50	2.875	.313	10.64	22.7	3.250	2.934	.158	5.216	46.1	2	3.500	3.196	.152	5.423	44.4								2.500	2.125	.187	4.642	52	13
6	3 1/2	9.9	321						3.50	2.750	.375	12.53	24.9	3.250	2.926	.212	6.950	45.5	2	3.500	3.096	.203	7.148	43.6								2.500	2.000	.250	6.008	52	13
7	3 1/2	8.5	241						3.438	2.813	.313	10.45	23.4	3.250	2.970	.148	4.65	50.3	2	3.312	3.164	.134	4.87	48	3.000	2.704	.148	4.508	52	7						
8	4	9.2	393						3.875	3.063	.406	15.04	25.4	3.375	2.913	.231	7.76	49.2	3	3.593	3.083	.225	7.95	48.1	3.000	2.580	.250	7.361	52	7						
9	4	7.7	317	4.000	2.750	.625	23.58	16.0	4.375	3.813	.281	12.29	25.7	4.125	3.835	.145	6.17	51.9	2	4.438	4.158	.140	6.48	49.5	4.000	3.784	.148	6.089	52	5						
10	5	13.8	924						4.938	3.688	.625	30.79	31.1	4.625	3.675	.475	21.05	42.6	1	4.775	3.845	.465	21.45	41.8	4.000	3.000	.500	18.69	48	7						
11	5	7.76	518	4.875	3.251	.812	45.25	14.9	5.375	5.000	.313	16.92	29.7	5.125	4.761	.182	9.609	52.3	2	5.500	5.150	.175	9.952	50.6	5.00	4.625	.187	9.602	52	5						
12	5 1/2	15.94	1288						5.750	4.500	.625	34.31	36.5	5.375	4.597	.489	25.52	49	2	5.552	4.572	.480	25.00	48.3	5.00	4.000	.500	24.03	52	5						
13	6	6.50	625	6.000	3.750	1.125	88.57	10.4	6.625	5.999	.313	21.07	28.0	6.250	5.888	.181	11.73	52	2	6.625	6.275	.175	12.06	50.3	6.00	5.625	.187	11.67	52	5						
14	7	15.91	2081						6.875	5.061	.907	57.81	34.9	6.500	5.010	.735	45.26	44.6	2	6.656	5.106	.725	45.52	44	6.00	4.500	.750	42.05	48	5						
15	8	7	1198	8.250	5.250	1.500	108.1	10.8	9.250	8.074	.650	41.22	18.2	8.750	8.262	.244	27.17	52.3	3	9.375	8.905	.235	27.94	50.6	8.625	8.135	.250	27.34	52	5						
16	9	15.9	3439	8.750	4.750	2.000	144.2	23.2	9.250	7.000	1.125	97.62	34.2	8.750	6.782	.984	81.61	40.9	2	9.125	7.145	.965	84.10	39.7	8.625	6.625	1.000	81.64	41	5						
17	9	8	1817	9.500	6.500	1.500	128.2	13.6	11.000	10.064	.468	52.96	33.3	10.750	10.124	.313	34.89	50	2	10.875	10.367	.304	35.95	48.9	10.75	10.135	.313	34.89	50	4						
18	9 1/2	11.9	2851	9.875	5.875	2.000	168.2	16.9	11.125	9.875	.625	70.92	29	10.750	9.746	.502	54.96	49.8	2	11.250	10.270	.490	56.30	48.6	10.75	9.750	.500	54.74	50	4						
19	11 1/2	6.1	2166	11.500	7.500	2.000	202.92	10.3	13.375	11.499	.468	64.51	31.2	13.250	13.124	.313	41.58	30	2	13.448	11.858	.305	41.88	48.5	12.75	12.125	.313	41.67	50	4						
20	11 1/2	11.9	4216	11.750	7.750	2.000	208.16	19.4	13.250	11.750	.750	80.13	40.4	12.750	11.494	.629	81.31	49.8	2	13.181	12.081	.615	83.19	48.6	12.75	11.500	.625	80.94	50	3						
21	12 1/2	5.7	2389	12.750	8.750	2.000	229.66	10	14.500	13.564	.468	78.14	52.9	14.000	13.374	.313	45.75	50	2	14.448	13.858	.305	46.14	49.6	14.00	13.875	.313	45.75	50	3						
22	12 1/2	11.2	4450	13.125	9.125	2.500	283.68	15.7	14.500	13.000	.750	100.13	40.5	14.000	12.734	.625	89.01	50.2	2	14.625	13.295	.615	93.03	48.5	14.00	12.750	.625	89.18	50	3						

Figure 2 — Typical rolling schedule for plug mill type seamless tube mill.

7. Billet heating furnace.
8. Reheating furnace ahead of plug mill.
9. Reheating furnace ahead of reducing mill (and sizing mill).

After the round solid billet has been uniformly heated to piercing temperature, approximately 2300 F depending on type of steel, it is conveyed to piercing mill No. 1. The piercing operation is the most essential operation in the manufacture of seamless tubes, because it transforms the solid billet into a hollow cylinder. Eccentricity of wall and inside defects can easily occur in this first operation. Later rolling operations cannot correct these conditions. It is for these reasons that the experienced operator gives this first piercing operation the greatest attention. Improved methods in heating the billet and changes in plug, roll and guide-shoe design have greatly decreased these irregularities and increased the yield.

From piercing mill No. 1 the tube is conveyed to piercing mill No. 2. The operation in this mill is very similar to the operation in piercing mill No. 1, except the work is limited to wall reduction only. Depending on size of the finished product and utilization of standard billet diameters, the outside diameter of shell in piercing mill No. 1 or No. 2 can be increased or decreased. It is conventional to limit the amount of increase or decrease to approximately 10 per cent. The wall reduction in piercing mill No. 2 as a rule is limited to approximately 50 per cent.

In many cases only one piercing mill is required, depending on the diameter and length of tube to be produced. For this reason the layout of the mill must be

Figure 3 — The most widely used seamless tube mill is the Mannesmann Mill.

arranged to permit the use of one or two piercing mills. Many installations are in use with only one piercing mill.

From piercing mill No. 2 the tube in most cases is reheated to a temperature of approximately 2200 F before being transferred to the plug mill. The number of

Figure 4 — Shown here is a two speed drive for a piercing mill.

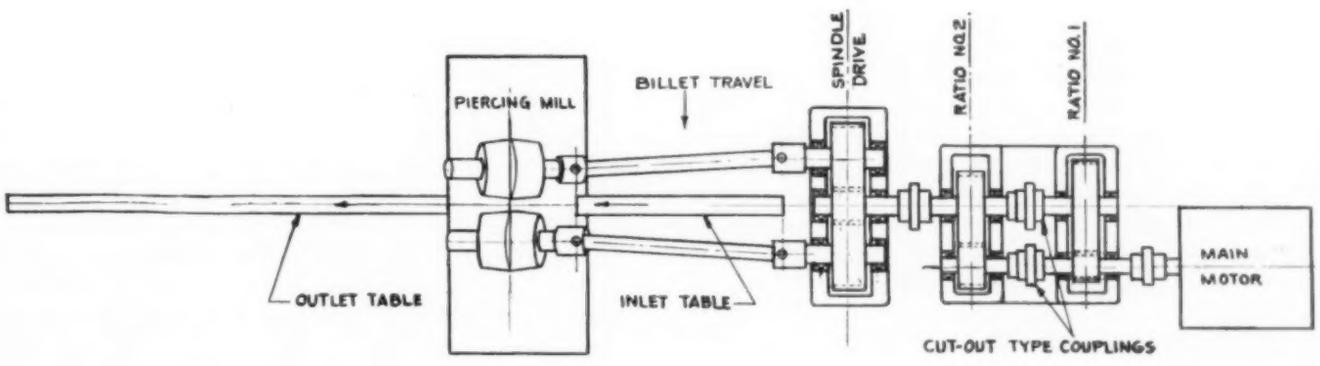


TABLE I — Chart Showing Capacities and

Finished tube outside diam., in.	Billet diam., in.	Piercing mill No. 1					Piercing mill No. 2				
		Main rolls				Main motor, hp	Main rolls				Main motor, hp
		Max. diam., in.	Face in.	Rpm	Feed angle, degrees		Diam., in.	Face, in.	Rpm	Feed angle, degrees	
1½ to 5½	2¾ to 5½	30	20	125	5 to 12	1500	.....	.....	.....	.....	.....
3 to 8⅝	3 to 8	38	26	95	5 to 12	2500	38	26	100	5 to 12	2500
5½ to 16	5½ to 14	51	30	72	5 to 12	5000	51	30	78	5 to 12	5000

NOTE: All main motors should be selected for a maximum load of 300 per cent.

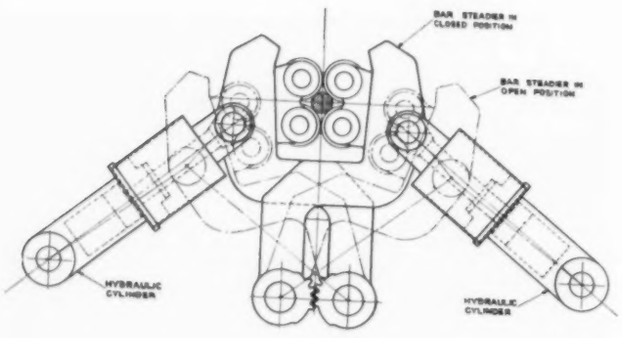


Figure 5 — The mandrel bar steadier shown is hydraulically operated.

rolling passes given in the plug mill is determined by the desired wall and outside diameter reduction; however, the number of passes should be kept to an absolute minimum for two reasons:

1. Not to retard production.
2. To avoid the possibility of inside scratches.

In most cases two rolling passes are used.

The wall of tube in the plug mill is reduced by rolling the tube over a stationary round plug. The grooves in roll are greatly relieved on side, making the pressure zone between roll and tube approximately 120 degrees for each roll or 240 degrees for the two rolls. Between successive passes the tube is rotated 90 degrees. It may happen that in this rolling operation of tube, the tube wall is not reduced uniformly around the circumference. In the following reeling operation these wall variations are ironed out and at the same time a smooth inside and outside finish is produced.

The operation in the reeling machine is very similar to the piercing mill except that a parallel pass is used which must be long enough to produce a smooth inside and outside finish. Due to the longer length of tubes going through reeler and the necessarily slower feed, two reeling machines are required to keep up production with the piercing mill and plug mill. The tubes are alternately fed through the two reelers.

During the reeling operation the outside diameter of tube increases approximately as expressed by the formula: $\frac{\text{outside diameter}}{64\ \text{wall}}$. The average wall reduction is limited to approximately 3 to 5 per cent.

The outside diameter of tube coming from the reeling machine cannot be held to close tolerances, and a final sizing operation is required to produce a tube which will have the outside diameter tolerances demanded by the industry. For the sizing operation it is customary to use a five or seven-stand sizing mill. Due to the wall upsetting effect in reducing the outside diameter of a tube, the outside diameter reduction in sizing mill is limited to approximately 3 to 3½ per cent per pass. The sizing mill stands have rolls with oval grooves except for the last two passes which have round grooves for rounding up the tube and establishing the final diameter. Successive stands are located 90 degrees with respect to one another. In most cases rolls are arranged in pairs inclined 45 degrees to floor level. For sizing only a three-stand sizing mill would be sufficient, however, a five, or better, seven-stand sizing mill will give the operator opportunity to produce slightly different outside diameter tubes by changing the roll setting in the sizing mill. This can be done without changing the set-up of the piercing mill, plug mill and reelers. By these means tubes with a variation of ¼ to ½ in. outside diameter can be produced.

Due to the difficulties encountered with small diameter mandrel bars and plugs, it is desirable to limit the outside diameter of tubes leaving reelers to about 2⅞ in.

Smaller outside diameter hot rolled tubes are produced by further reducing in sizing mill and/or reducing mill. From a production point of view it is also advantageous to finish the tubes off the reeler as large as possible in diameter and reduce to finished diameter in sizing mill. Amount of reduction is limited by upsetting effect of wall.

In order to produce hot finished tubes 1½ in. outside diameter, a reducing mill of 18 to 22 stands is used. A total reduction in outside diameter from 3 to 1½ in. is the maximum practical in a conventional reducing mill.

Data of Typical Seamless Tube Mill Installations

Plug mill				Reeling machine				Sizing mill					Reducing mill				
Main rolls			Main motor, hp	Main rolls			Main motor, hp	Rolls			Number of strands	Main motor, hp	Rolls			Number of strands	Main motor, hp
Max. diam., in.	Face, in.	Roll, rpm		Max. diam., in.	Face, in.	Roll, rpm		Max. diam., in.	Face, in.	Delivery roll speed, rpm			Diam. in.	Face, in.	Delivery roll speed, rpm		
22	60	120	1000	24	22	150	350	16	8	60	5 or 7	250	12 to 14	6	100	18 to 22	400
26	60	100	1500	30	24	140	400	18	11	50	5 or 7	350	.....	.....	.....	.....	.....
40	60	62	2000	36	28	90	600	32	22	28	5	400	.....	.....	.....	.....	.....

Due to the upsetting effect of wall, which is inherent in a diameter reducing mill, reductions are necessarily limited. Excessive reduction will change the inside from round to a hollow with pronounced corners.

In the reducing mill, same as in the sizing mill, the maximum reduction per pass is limited to approximately 3½ per cent. The arrangement and shape of grooves in reducing mill is the same as in the sizing mill. While it is possible to size tubes coming from reeler without reheating, most operators prefer a reheating furnace ahead of sizing mill for the reason that the temperature of tube entering the mill will be more uniform, with the result that the finished tube will have a uniform diameter from end to end. The reheating furnace ahead of reducing mill is an absolute requirement.

A chart of typical seamless tube mill installations is shown in Table I.

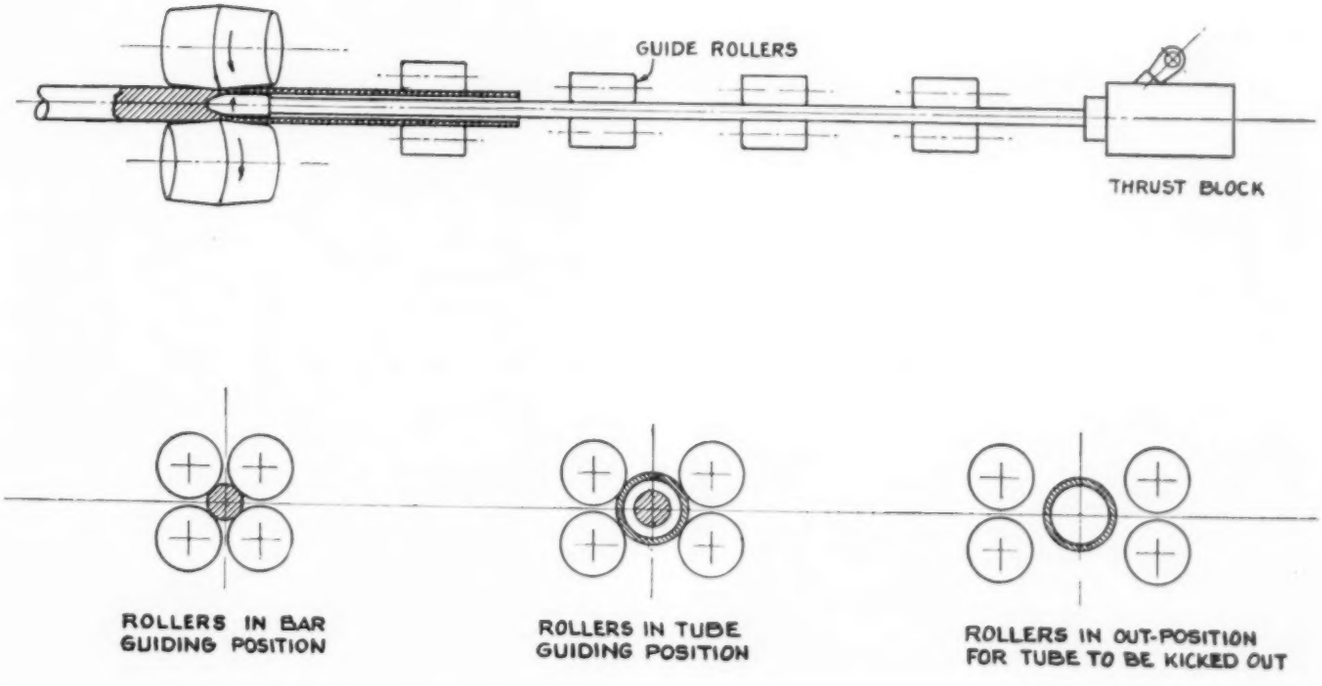
A chart showing typical rolling schedule for various tube sizes from solid billet to finished hot rolled tube size is shown in Figure 2.

In the following, design improvements will be described which have been made in the various machines.

PIERCING MILL

Figure 3 shows a typical Mannesmann or parallel axis barrel type piercing mill. This type of mill is more widely used than any other type of piercing mill. In the last few years the following improvements have been made in design:

Figure 6 — Sketches illustrate roller type bar and tube guide for piercer outlet table.


GUIDE ROLLERS
THRUST BLOCK
ROLLERS IN BAR GUIDING POSITION
ROLLERS IN TUBE GUIDING POSITION
ROLLERS IN OUT-POSITION FOR TUBE TO BE KICKED OUT

1. Anti-friction bearings have replaced sleeve type main roll neck bearings. The introduction of anti-friction bearings has eliminated the shifting and moving of rolls encountered by plain bearings after some wear. The anti-friction bearings make it possible for the operator to adjust the rolls and piercer plug accurately to the desired pass. Piercer roll face has been increased to be able to use the same rolls for a reducing or expanding pass.
2. Pass entry and leaving angles have been decreased. Together with improved plug and guide-shoe design, the pass feed efficiency has been increased from 35 to about 65 per cent.

Based on a roll surface speed of 1000 fpm, feed speed of 20 to 22 in. per second are common today. The theoretical feed speed for a roll speed of 1000 fpm and feed angle of 10 degrees $= \frac{1000}{60} \times \sin 10 \text{ degrees} \times 12$ $= 34.6$ in. per second. Feed efficiency $= \frac{\text{actual feed}}{\text{theoretical feed}}$ $= \frac{22}{34.6} = 0.65$ or 65 per cent.

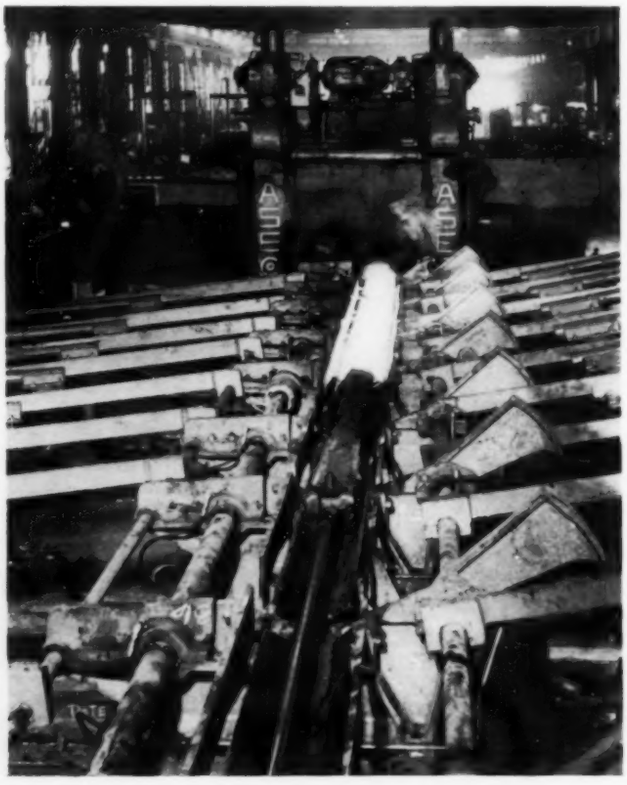
It will be of general interest to know that one company has successfully used a roll surface speed of 1500 fpm and obtained a delivery speed of 36-in. per second. It was found that this high speed requires exceptionally good guiding for billet and mandrel bar.

3. Piercer inlet tables have been redesigned to give more rigidity. The vertical adjustment has been motorized to facilitate accurate adjustment with a minimum of effort and time.
4. It has been found desirable to pierce certain alloy steels with roll speeds of approximately 750 fpm. To accomplish this with the use of a-c power and at the same time still have available a speed of 1000 fpm for ordinary carbon steels, a two-speed drive has been incorporated in spindle drive. Figure 4 shows a typical arrangement of this type of drive. Drives of this type are in use with capacities up to 10,000 hp.
5. In the construction of piercer outlet tables the following improvements have been made:
   a. The old marine type thrust bearing has been replaced successfully with anti-friction bear-

Figure 8 — The piercing mill shown is used in the non-ferrous industry.

Figure 7 — Photograph of piercer outlet table whose operation is schematically indicated in Figure 6.

Figure 9 — Typical plug rolling mill.



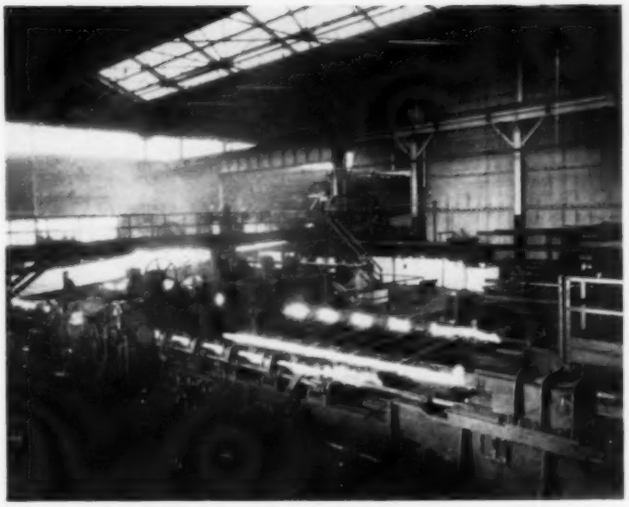


Figure 10 — Modern reeling machines are now using anti-friction bearings instead of the roll neck bearings previously used.

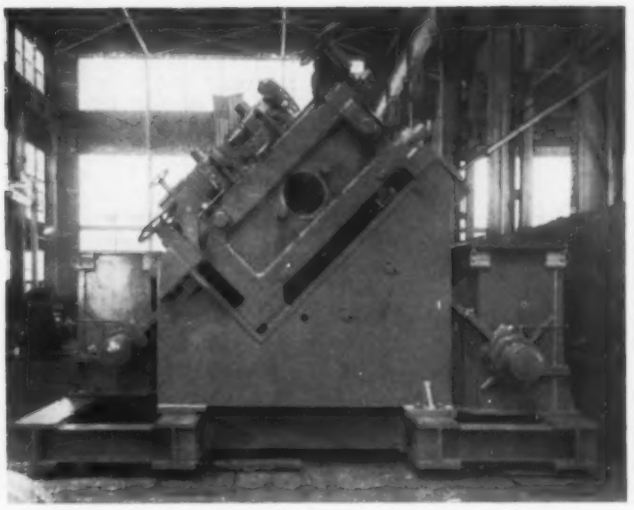


Figure 12 — Closeup of straddle mill illustrated in Figure 11.

ings. This has greatly reduced maintenance on thrust blocks.

Electrically operated thrust block traverse drives are used with average speeds of 12 fps. Variable type voltage control and induction type limit switches, without mechanical contact between thrust block and limit switches, have been successfully used.

b. A new hydraulically operated bar steadier is under construction, shown in Figure 5. The hydraulic circuit is arranged so that after bar is in guided position the live pressure can be maintained in cylinder or the oil can be trapped in cylinders.

The bar steadier is opened automatically. The opening is initiated by the approaching tube through synchronic control. The closing of the bar steadier is done through pushbutton control by the operator.

A new type of outlet table, combining roller type tube and bar guides, has been in operation successfully for approximately a year. The design of this table is shown in Figures 6 and 7. Indicators are provided for the adjustment of rolls for a given bar and tube diameter. The particular table shown in Figure 6 and Figure 7 is arranged for a minimum bar diameter of 2 in. and maximum tube diameter of 9 in.

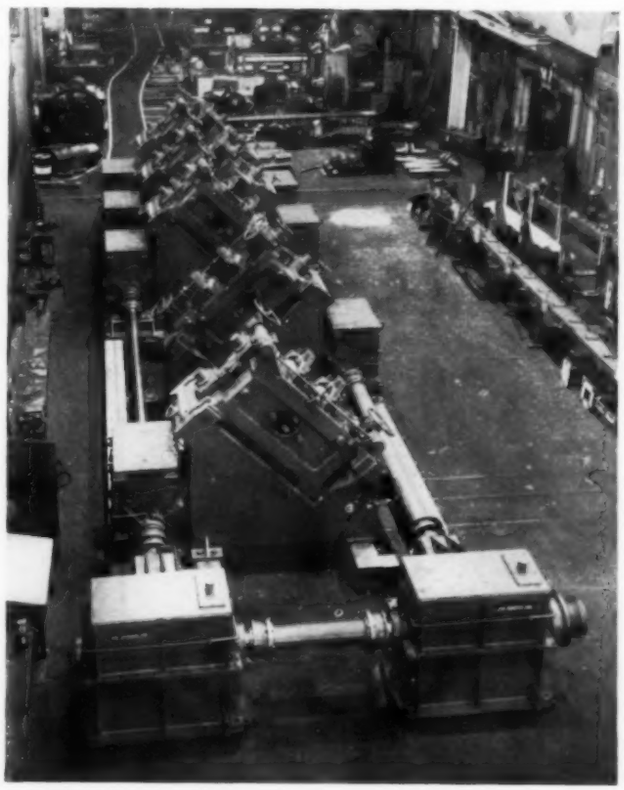
The opening of rollers changing the guide from a bar to a tube guide is automatic—the same as mentioned before under hydraulically operated bar guide. Through a latch arrangement the rollers are positively locked in place in both the bar and tube guiding position. For removing the tube after mandrel bar has been withdrawn, the rollers move to a wide open position. To change the setting for a different rolling schedule requiring different bar and tube diameters, only a few minutes of the operator's time is required. No crane service is needed.

Figure 8 shows a new design of piercing mill used in the non-ferrous industry.

To facilitate the changing of guide roller used in this type of mill, the main piercing mill housing is of the C-clamp type without cap. This type of mill has been built for billet sizes ranging from 3 to 10 in.

To reduce the maintenance, new piercing mills are equipped with automatic centralized grease systems for roll neck bearings and universal spindles. A circulating oil system for drive is included complete with automatic filters and alarm signals in case of oil failure.

Figure 11 — In the straddle type mill shown, the rolls are supported at both ends.



When designing a piercing mill, the knowledge of roll separating forces and mandrel bar thrusts are most important. It is difficult to calculate these forces with good degree of accuracy. For this reason the designer in designing new units is guided by test readings from existing installations.

PLUG MILL

Figure 9 shows a typical plug rolling mill. No substantial changes have been made on this unit. Drives have been modernized to conform with today's practice. It will be of interest that one plug rolling mill in operation is equipped with anti-friction neck bearings and universal type spindles. To facilitate the changing of bearing cartridges on coupling side, the drive end of roll has a tapered end which fits into a tapered bore in universal coupling half.

REELERS

Figure 10 shows a typical reeling machine. The following improvements have been made: Roll neck bearings have been changed from plain bearings to anti-friction type. Inlet tables have been improved by the use of individually driven roller units. The preferred drive arrangement is to locate the drive at far end of inlet table and drive the main rolls through two line shafts. This type of drive arrangement makes the entry end of reelers accessible and eliminates a complicated drive design encountered when drive is located adjacent to reeler, in which case the tube has to pass through the drive.

Design of reeler outlet table is identical to piercer outlet table except for length. It is advisable to duplicate parts as much as possible for piercer and reeler outlet tables.

REDUCING AND SIZING MILLS

Both types of mills are designed for the same purpose, to receive the tubes coming from reeler and reduce the outside diameter to the desired finished size.

The number of roll passes used in sizing mill varies between three and seven. The number of roll passes used in reducing mills varies between eighteen and twenty-two. Twenty-two is the practical limit for reasons mentioned before.

The following types of mills are in operation:

1. Straddle type mill (rolls supported at both ends) with one motor drive. A mill of this type is shown in Figures 11 and 12.

In order to synchronize the various roll stands to avoid stretching or upsetting of tubes between stands, the roll diameter must be calculated so that the tube speed x cross-sectional area of tube remains constant for all passes.

Groove design for sizing mill rolls, calculation of spreading force and hp is given in the following sections. Figures 13 and 14 illustrate the terminology in the formulae.

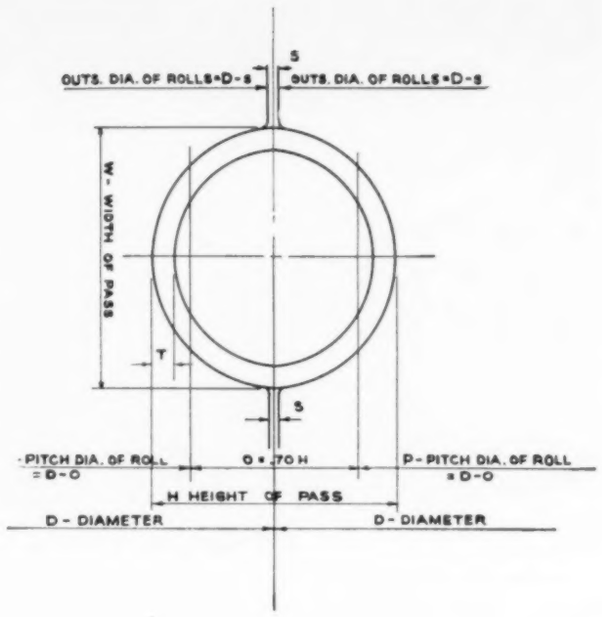
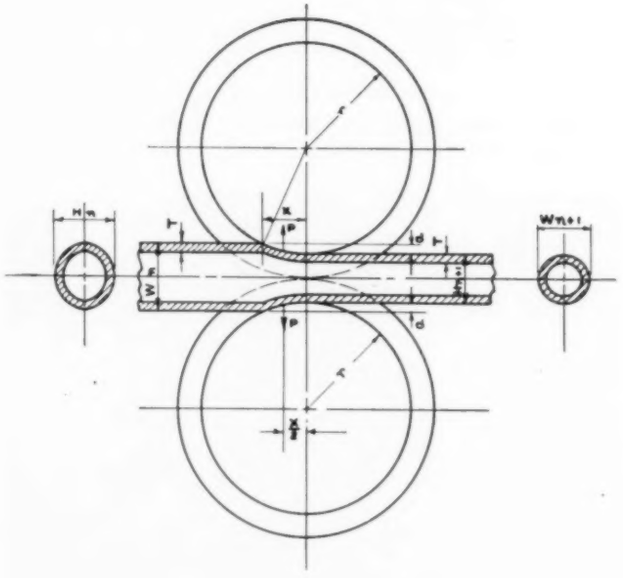


Figure 13 — Pass design proportions for tube reducing mills.

Figure 14 — Sketch illustrates nomenclature used for formulae for required pressure and horsepower.



PROPORTIONS OF PASS DESIGN

n = Index of pass number.
D = Distance, center to center rolls.
W = Width of pass.
H = Height of pass.
O = 0.70 × Height of pass for tubes.
P = D-O Pitch diameter of rolls.
d = Average outside diameter of tube.
T = Wall thickness of tube.

$d_n = \frac{H_n + W_n}{2}$ Average outside diameter of tube.

$d_m = d_n - T_n$ Average mean diameter of tube.

$A = d_m \times T \times \pi$ Sectional area of tube.

$$S_n = \frac{A_1}{A_n}$$ Relative longitudinal speed of tube.

$$R = \frac{d_{n-1} - d_n}{d_{n-1}} \times 100$$ Reduction on outside diameter of tube in per cent.

$$R_A = \frac{A_{n-1} - A_n}{A_{n-1}} \times 100$$ Reduction in area of tube in per cent.

$P_1 \times A_1 \times RPM_1 = P_n \times A_n \times RPM_n$ which is equation for constant volume of metal flow-rate.

$$W_n = \frac{H_n \times 100}{100\text{-}R}$$ Pass without side relief (In practice too close).

$$W_n = \frac{H_n \times 100}{100 - 1.5\,R}$$ Pass with side relief.

$$H_n = \frac{2\,d_n}{\frac{100}{100 - 1.5\,R}} + 1$$

$W_n = 2\,d_n - H_n$

$C_n = W_n - H_{n-1}$ Side relief.

TOTAL REDUCTION IN ALL PASSES

d_E = Outside diameter of tube entering first pass.
d_L = Outside diameter of tube leaving last pass.
T_E = Wall thickness of tube entering first pass.
T_L = Wall thickness of tube leaving last pass.

$$R = \frac{d_E - d_L}{d_E} \times 100$$ Total reduction on outside diameter of tube in per cent.

$$R_A = \frac{(d_E - T_E) \times T_E - (d_L - T_L) \times T}{(d_E - T_E) \times T_E} \times 100$$

Total reduction in area of tube in per cent.

ROLL PRESSURE AND HP REQUIRED

Length of Compressed area

$X^2 = r^2 - (r\text{-}a)^2$
$X^2 = r^2 - r^2 + 2\,ra - a^2$
$X^2 = 2\,ra - a^2$ (a^2 is very small and may be neglected).
$X^2 = 2\,a\,r$
$X = \sqrt{2\,ar}$ Length of compressed area
$2\,a = W_n - H_{n+1}$

Effective compressed area

d = Average ingoing outside diameter
X = Length of compressed area.
C_1 = A coefficient expressing ratio of actually compressed area to rectangle d × X which is for tubes 0.75 approximately.

$\frac{2 \times T}{d}$ Ratio of hollow section to solid section in direction of compression.

K = Resistance of material to compression.
$d \times X \times C_1 = 0.75 \times d \times X$ Effective compressed area.

Roll pressure $$P = \frac{0.75 \times d \times X \times 2\,T}{d} \times K$$

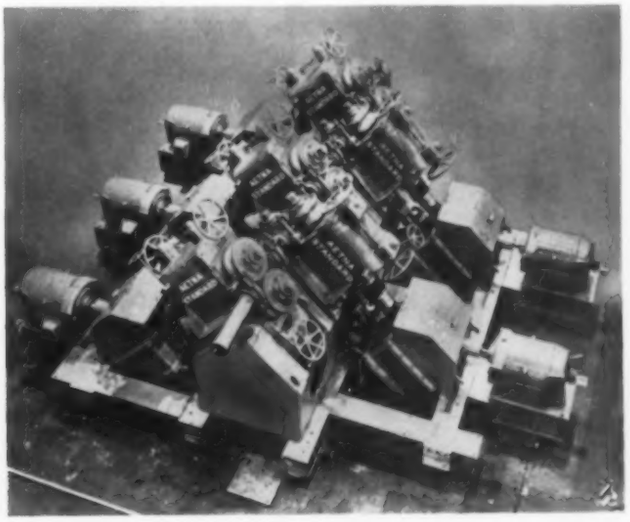
$P = C \times X \times T \times K$ $C = 1.5$

P Acts in a distance of about $0.5 \times X$ from roll center.
Torque $T = 2 \times P \times 0.5 \times X = P \times X$

$$Hp = \frac{P \times X \times rpm}{63025}$$ for deformation only.

Figure 15 — Individual motor drives are used on this tube mill.

Figure 16 — Either rolls or complete housings can be changed on the overhang roll type mill.



μ = Efficiency of process and mechanical efficiency of mill with drive; varying from about 0.5 to 0.65.

$$Hp = \frac{P \times X \times rpm}{63025 \times \mu}$$ Total hp required.

It can readily be seen that with the same outside diameter tube entering and leaving, theoretically a different set of rolls is required for each wall thickness. With the same outside diameter reduction, the area reduction increases with the wall thickness. For this reason a pass correctly designed for a given wall will cause stretching when used for lighter walls and upsetting for heavier walls.

If the wall variations, or cross-sectional area variations, for same outside diameter reduction in per cent are not too great, the pass is to be designed for the average wall.

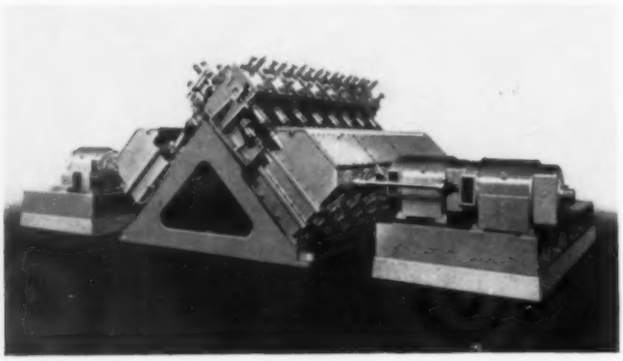
The mills have been modernized by incorporating anti-friction bearings for roll necks which made a greatly simplified axial groove adjustment possible. The use of anti-friction bearings also permits tubes to be sized to closer tolerances. Maintenance has been reduced by the incorporation of hardened steel liners in housings and housing supporting bases, also by the incorporation of circulating oil system for drives and automatic centralized grease systems for roll necks.

The same type mill with individual motor drives is shown in Figure 15. Advantages are greater flexibility, the roll passes can be properly synchronized for given outside diameter reduction, and various wall thicknesses. Rolls also can have the same diameter, which makes it possible to design one master set of rolls to cover complete rolling schedule for all diameter tubes to be produced.

2. Overhang roll type mill. Figure 16 shows this type of mill. For a size change either rolls or complete housings can be changed. Advantages are that rolls can be changed without removing bearing chucks. The particular mill shown in Figure 15 was designed for 9 in. maximum outside diameter tubes and 20 in. roll diameter.

Figure 17 shows an overhung type mill designed with minimum center distance between roll stands. The mill shown has sixteen stands, with 12 in. diameter rolls spaced on 12½ in. centers.

Figure 17 — The mill shown has been designed to minimize the center distance between the roll stands.



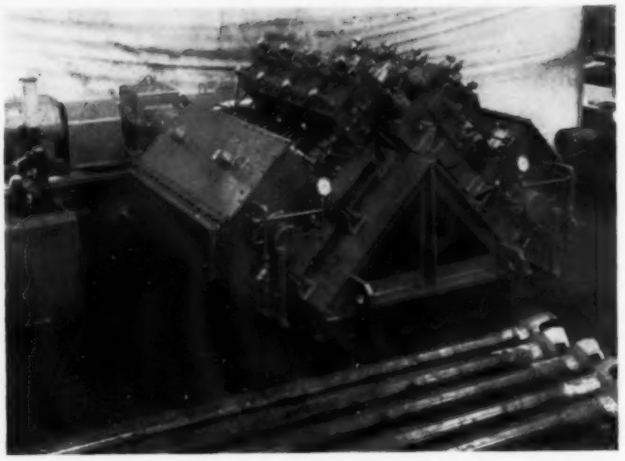


Figure 18 — This mill which has 8 roll stands is driven by a single motor.

Each stand is driven by a 75 hp motor with a maximum capacity of 250 hp. The mill has been used for stretch-type reducing.

Another mill used for stretch-type reducing is shown in Figure 18. This mill has 8 roll stands, 10 in. diameter rolls spaced on 10½ in. centers. The mill is driven by one motor. All rolls have the same diameter. Based on the desired reduction, the gear ratios vary from stand to stand. Special pickup gears were provided to change ratios readily.

In the selection of type of sizing mill or reducing mill the following factors must be considered:

1. *The importance of center distance.* When stretch-type reducing is used for individual tube lengths, the center distance between stands is most important and should be kept to an absolute minimum. The scrap loss increases materially with increased center distance between stands. An overhung type mill can be built with closer center distances than the straddle type mill.
2. *Importance of time required for size change.* If the time required for changing rolls holds up production this factor is most important. From observation it seems to be a fact, at present at least, that a size change can be made quicker on a mill designed for complete housing change. However, with proper roll handling equipment, power wrenches, etc., the roll change time on an overhung type mill can be greatly reduced.

   The total man hours required for changing rolls on a straddle type mill are greater than the hours required for changing rolls on an overhung type mill. Of course, most of this work is being done on the spare stands while the mill proper is in operation. In some cases a roll change in sizing mill or reducing mill does not hold up production. While one mill is being changed the other is in operation.
3. In some cases of account of limited production, the investment must be kept to a minimum. For a mill used on small diameter tubing where spreading forces are not too great, an overhung type mill can be built at a lower cost than a straddle type mill with extra spare housings.

Always More Production

By S. J. CORT
Vice President
Bethlehem Steel Co.
Bethlehem, Pa.

S. J. CORT

. . . . address presented at annual AISE Spring Conference banquet in Baltimore, Maryland on May 2, 1949 . . . .

▲AS a fellow production man, my life has been spent in the production end of the steel industry. On my office wall has hung for many years a photograph with an inscription on it which has always been my motto. The photograph is a picture of Mr. E. G. Grace, chairman of the Bethlehem Steel Co., and the inscription which he wrote years ago says "Always more production."

"Always more production," is the theme of this paper. How can we get more production, what are the obstacles that stand in the way, what are some of the possibilities that are being realized?

First of all, more than any other engineering group, the Association of Iron and Steel Engineers is closer to the grass roots of production. The membership includes foremen, superintendents, and other supervisory personnel, as well as engineers, metallurgists, and research technicians. Consequently as a group you have a broad knowledge of the various phases of production.

Production, a complex job—How much more production is needed to supply the national economy is a subject of current debate. You hear all sorts of figures mentioned from 10,000,000 ingot tons on up. I am not going to discuss economics, or guess at what the additional capacity should be, or whether the immediate future requires any more capacity than is already planned. It is my purpose to deal with the practical phases of what is involved in production, which in turn may give us a little clearer idea of the problem as a whole.

Production is not something that you get just by turning on a switch, not just a speeding up of equipment because someone says that a ten per cent addition to output is needed. No, it is a very complicated process. At many points along the line, a deficiency in one factor or another can cramp your ability to produce.

Raw materials—Let us take the raw material problem first. The raw material end right now is one of the most important things we have to consider. If someone could now wave a wand and add 10 million more tons of furnace capacity to our plants, there would not be the raw materials to support it.

The supply of iron ore is going to be a main problem for the production end of the steel industry from here on. I am not an alarmist. The world is not going to run out of ore, but the quality that we may expect and the distances which will be necessary to transport the ore will be a real problem.

The high production demands of the war, coupled with the cutting off of foreign ores, meant that the steel companies were obliged to strip away the best of the domestic supply. There was no time or opportunity to develop resources in an orderly manner, which would have been the proper course in peacetime. Steel for all the implements of warfare, in quantity, as fast as possible, was the prime need.

The high grade ores from domestic sources were being depleted anyhow, but the war accelerated the process. Certain authorities have predicted that in the near future our present source of high grade ore will be a thing of the past. Whatever the period, it is a fact that the low-cost, high grade ore will progressively become less and less available. We might as well face that fact as one of our big production challenges.

Beneficiation plants are one answer, at a price. The cost of developing these may run into the billions. Moreover, the process of handling the material will require some adjustment in our equipment, which in turn will mean more costs.

For many years, foreign ore supplies were thought to

Presented before AISE Annual Spring Conference, Baltimore, Md., May 2, 1949

be an easy answer to the problem of what to do as domestic output dwindled. Unfortunately, this resource has become a very qualified benefit. True, there are good iron ore deposits in Latin America, Africa, Labrador, and elsewhere, but the high cost of water transportation has diminished their attractiveness. I do not believe that the public realizes the changes that have come about in water transportation cost, but you men are aware of them.

Another factor is that the countries in which the iron ore occurs are becoming very nationalistic and appraising their natural resources at a much higher figure than formerly. This, with the unstable character of some of the governments and the taxes that are put on foreign corporations, complicates the problem of expenditure of large amounts of our capital.

In addition, foreign ores to become available for many plants involve the cost of rail haulage, either in the foreign country, or after reaching the United States, or both. Take the Labrador deposits as an example. It has been estimated that $250,000,000 would be needed to develop these mines, and that would not include the cost of delivering the ore to points in the United States. The cost of constructing sea-going vessels to handle this ore to the United States ports would mean an investment of additional millions.

I have dwelt on this iron ore problem, not to be alarming, but because I believe that from now on it is going to be more and more an outstanding problem in both the cost and technical elements of production. Our ores are going to have to be beneficiated or hauled a great distance. That will increase the pressure for trying to find more economical means of processing in the plant.

Decline in quality of coal—A somewhat similar condition has developed in respect to the coal supply. Much of the good high volatile coal in the country has been or is being exhausted very rapidly. I can recall when we would specify in ordering coal a 1 per cent maximum in sulphur and not over 6 per cent in ash. You know how impossible that would be today. Hence we have the new cost burden of coal-washing equipment in the mines. Similarly, the supply of high grade limestone is disappearing in some sections, which brings up new problems in handling inferior grades.

The recurrent work stoppages in the coal mines have caused the loss of steel production and have been detrimental to the proper maintenance of our by-product coke ovens. The ever-mounting cost of coal, due largely to the labor situation, accompanied by the decline in quality, has added another headache to the job of steel production.

Improvements in scrap—A somewhat more optimistic outlook may be seen in the availability of scrap. Prior to World War II, approximately 20 million tons of scrap from our country was exported to Japan and Europe which depleted our home stocks, and during the war, probably 150 million tons of steel and scrap were lost to this country in military supplies shipped abroad and vessels sunk by the enemy. The high production rate since the war continued to draw to the limit on the existing supply, and the scrap shortage was a deterrent to further increases in production.

That situation has improved, however. Battlefield scrap is beginning to come back to the United States from Europe and the Orient. Obsolete ships and other equipment are becoming available for scrap. Then, too, we are again getting back our normal percentage of scrap from the manufacturers who process steel.

Further, our wartime experience taught us some useful and permanent lessons in the economic handling of scrap, such as better sorting, recovery of alloys, and better bundling.

The improved scrap outlook, however, does not offset the other raw material problems, nor does it counterbalance the ever-mounting rail and water rates which are a tax on everything that comes into the plant. I am not criticizing the transportation companies, nor our suppliers, but the fact remains that every element in our production now costs us more, our machinery, our new furnaces, our equipment, materials and supplies.

In any addition to our steel producing capacity, the metallics for it will have to come from iron ore rather than from scrap because by better metallurgical processes, we have increased the yield from the ingot which cuts down the amount of home scrap available; and also with better quality steel the life of the products we manufacture is extended which means that the cycle is longer before our steel comes back to the plants as scrap.

Gains in production capacity—"Always more production"—how is that going to be achieved in the face of the difficulties which I have mentioned? First, we may take a glance at what has happened in the past 30 years. At the end of World War I the capacity of the steel industry was 57,000,000 net tons of steel annually. Today the rated capacity is 96,000,000 net tons annually. A large majority of that gain was obtained by building new blast furnaces and open hearths, but it must not be minimized that a great many technical improvements were made in our existing blast furnaces and open hearths which materially raised their production.

Today there are two frequently discussed questions with respect to adding to capacity. One is: How can you afford to add to capacity at present cost levels? The second is: Do the present capacity figures reflect the actual productive ability of the various steel plants?

I think that the second question can be settled briefly. At present the capacity rating method is being studied by the industry, but in my opinion the present capacity estimates are conservative. In actual practice many plants have been running in excess of rated capacity for a considerable period. I realize that some highly reputable statisticians are accustomed to lop off a percentage of rated capacity to allow for furnace relining and repairs, but that seems currently to be offset by various improvements that have come about in steel operating practice. For example, it is the custom, in rating a capacity, to allow 12½ per cent for down time for repairs and miscellaneous delays. In actual practice, during the war years, this figure has been nearer 6 than 12½ per cent.

In answer to the first and chief question of how we can add to capacity at present cost levels, the production of pig iron is being increased by enlarging the hearths of our existing blast furnaces, by the use of carbon bricks in place of refractory brick with the resultant gain of from 15 to 21 inches in the hearth dimen-

sion; also better preparation of the raw materials going into the furnaces. This is being accomplished by improvement in quality of coke through coal washing and blending and the construction of additional by-product ovens, by the screening and sizing of ores, sintering of fines, and better preparation and sizing of limestone. Where inadequate blowing capacity was a factor, new blowing equipment has been added.

The output of our open hearths in a great many of the older plants has been increased very materially by enlarging the size of present hearths, larger ladles, the addition of heavier ladle cranes to handle the larger heats, new charging and stocking facilities, more efficient checker capacity and automatic combustion control.

A great many claims have been made as to the ability to increase steel capacity by using oxygen to improve combustion, but to date the balance between more rapid melting and loss of time due to extra wear on refractories has not been determined.

However, time has been gained by the introduction of oxygen in the bath to eliminate carbon in low carbon heats and anywhere from 30 minutes to an hour has been gained. The door has not been closed as to the possibility for increased production by the use of oxygen, and research on this subject is continuing.

Also, as you know, experiments are going forward in the use of low-purity oxygen on the blast furnace. You are also aware that a low-purity oxygen plant is now operating in one of the plants of the company I represent where experiments are now under way with the use of oxygen in one of our blast furnaces, and I shall anticipate your questions by saying that we do not yet have enough experience to warrant any conclusions. Other steel companies are building plants for the purpose of producing oxygen for experiments in their blast furnaces and open hearths.

Whatever the result may prove to be from these oxygen experiments, the effort is worth making for it is a logical element in the many approaches which are being made to try to obtain increased production and effect economies. Millions of dollars are spent by the steel companies each year in research, and there is continuous trial and error. As someone has said, if you can bat at least 400, that is good in any league. Or, put it another way, do not ever hesitate to try something new, or to recommend something new just because you can not be sure whether it will work or not. This industry was built by men who were not afraid of experiment and venture.

Another of the current improvements which has been much discussed is that of the continuous casting process. That, too, is still in the experimental stage. If it works out successfully for certain applications it still will affect only a very small section of your production process. I mention that only to caution against the human tendency to look for a miracle. This process and others have been referred to by optimists outside of the steel industry as though they would greatly reduce the necessary investment in a new plant. Those of us who deal at first hand with production know that is not the case as far as the bulk of the production process is concerned. Such economies as we effect, such improvements as come into being, in the main will be due to the accumulated value of many undramatic little things, each one little, but all highly important when added together.

Production for different markets — "Always more production"—but production of what? Both the steel industry and the public talk about ingot production as the measure. That is a sound enough procedure when you are talking of general trends, yet in our every-day work the furnace departments are but one part of the job.

The buyer of steel too is not worried about ingots, as a practical matter, but is looking for plates, shapes, bars, sheets, or whatever material concerns him. So your production problem is relatively a two-way job. Looking from the inside out, we ask ourselves what finishing capacity do we need to take care of our ingot production, and from the market end the question is what ingot capacity is needed to support the necessary finishing mills. Obviously, we always need to bear in mind that the addition of a new mill affects the whole operating balance of your plant, both from an operating and a cost standpoint.

In a moment, I shall give you a brief optimistic picture of what has taken place with respect to certain steel products; but first I would like to point out that the cost situation is acute here as well as in the raw materials end. New construction bills are staggering. The cost factor has to be a paramount consideration in every project that is up for discussion. I think, for example, of a certain new mill that had been approved for construction at a large steel plant (I am not referring to Sparrows Point). The original estimate on the cost had been around six million dollars, but when bids were opened they totaled nearer to 12 million. The project had to be abandoned, as the mill could not have earned its way.

A great number of the projects proposed, however, have been carried into effect by the leading steel companies, and much is still underway. The steel industry, in my opinion, has shown the greatest courage in making huge investments in its finishing departments, as well as in ingot production. I hope and believe that this fact is gradually being recognized by the public at large. The steel industry has made phenomenal strides in certain departments, notably in the lighter weight steels. Taking 1940 as a pre-war base, in the short space of seven years we find an increased shipment of nearly 2,000,000 tons in hot rolled sheets; 2,500,000 tons in cold rolled sheets; pipe shipments are up 2,400,000 tons in the same period. Bars are another product up 2,500,000 tons. Wire and wire products also showed big increases.

Most of these increases were due to huge investments in new mills, though some of the increase was made possible by the improvements of existing equipment. In certain other cases the available capacity for a particular product may not have been fully called upon.

An encouraging element in this complex picture is the evidence that the steel industry has shown the ability to be flexible and to meet new phases of public demand as they come along. In fact, the steel companies did more than meet demand when it came. In many cases they anticipated it. Much of the flat-rolled capacity was built a considerable time ahead of demand.

An equally important obligation on the steel producer is to have the courage *not* to build, if that is his

judgment even when the outside pressure to build is strong.

In that connection, you may recall the shortage of nails. The nail shortage definitely was acute. There was a great clamor in some quarters for new capacity, but that was not the answer. The answer was to be found in some improvements to existing equipment, plus the assignment of sufficient steel for the nail-making plants to take care of the situation until the shortage was relieved. As a result, we find nail shipments advancing from 600,000 tons in 1945 to 800,000 tons in 1947.

In short, each production situation, the providing of capacity for making each type of product calls for a separate decision in each case. Hence when we have the goal of "always more production" we are referring both to the aggregate and to the separate parts.

How to determine the right answer is, of course, the continuing job of all of us who are in production. We must look to our commercial research to guide us as to the market trend for the individual steel products as far as that can be determined. We must constantly use our own creative energies, aided by the technical research people, to discover more economies and more ways of stepping up production.

All along in these comments, I have assumed that "always more production" is a proper goal. In conclusion, I would like to say why I think it is. I do not hold with statisticians who lay a ruler stantwise on a chart and point to it, saying "there is where your production demand is going to be next year, the year after, and so on." It does not work that way. Most of you have probably seen a production chart for the steel industry over a period of years, and you have noted its frequent zig-zags. Capacity has gone up steadily and slowly, but production has been subject to distortions of war, booms and depressions.

While we have had many ups-and-downs in the production line, the fact does remain that the general trend has been upward. The fact that our output has not risen more sharply may indeed have its favorable side. The industry has had to stand for much criticism for not supplying all interests at once, or as much as they wanted, when they wanted it. Had it been possible to do so, we might now be on one of the downward trends. Therefore, I feel that this situation, where we are catching up gradually rather than all at once, has its healthy aspects.

For the future, I believe that at least for your lifetime and mine the steel industry in the United States is going to keep right on growing. The obstacles are tougher than they used to be, but they will be overcome.

In closing, I would like to say a word about the human factor. An alert management having leadership and understanding, coupled with a cooperative, efficient working force, are the greatest resource that any plant can have. Today's problems call for the best united efforts of all who have to do with plant operations. More than ever in these times, good relationships are vital to getting the most effective results. I am sure that all of you in the management force, whether you are supervisors or technicians, realize that. In short, with full use of our human capacity, as well as our ingot capacity, we shall meet the challenges that lie ahead.

Some Aspects of Large and Small Blast Furnace Operation*

By G. P. BURKS

Division Superintendent of Blast Furnaces

Gary Works, Carnegie-Illinois Steel Corp.

▲ THE primary conclusion reached from this comparison of large and small blast-furnace operations at Gary works was that the iron production per unit of hearth area of large furnaces will approach that of small furnaces when high-grade raw materials are available for both. Conversely, as raw material quality deteriorates, the small furnaces can be expected to maintain a proportionately higher iron production rate than the large furnaces.

Coke rates of large and small furnaces remain comparable even while the trend is upward due to deteriorating quality of raw materials.

Silicon content of the iron produced by large furnaces is more uniform, as indicated by standard deviation studies.

In any comparison of large and small furnaces, it is believed that one of the most significant factors is the quality of raw materials available.

Gary works is in a favorable position to correlate the effect of raw material quality inasmuch as the blast-furnace department has twelve furnaces whose hearth diameters range in size from 20 ft 6 in. to 28 ft.

During the war years, the quality of the available coking coals steadily decreased, resulting in poorer grades of coke and deteriorated blast furnace practice, a condition prevalent throughout the industry. For this investigation, the practices of the large and small furnaces at Gary works were segregated, and combined in the form of yearly averages for each group for the six-year period from 1942 through 1947. In this way the reaction of the large and small furnace groups was examined as the coke quality gradually deteriorated.

Essentially the same materials were used on both groups of furnaces during the period considered. Day-to-day variations in materials were compensated by the spread of the data, and overall variations were the same in both groups.

Both groups of furnaces were being blown with as much wind as the furnaces could economically take.

Any data where the time "on blast" during the months was not approximately average were eliminated from the averages. Also, only months where the major portion of the tonnage produced was either basic or blowing iron were considered.

*Condensation of a paper presented at the 32nd Annual Conference of the American Institute of Mining and Metallurgical Engineers in Chicago, Ill., April 18-20.

A Decade of Experience

IN AIR CONDITIONING OF CRANE CABS

By WM. ALAN LINTERN
President
The Lintern Corp.
Berea, Ohio

▲ Over recent years, the betterment of conditions under which operators of hot metal cranes, pit cranes, etc., must work has made vast strides. Early attempts along this line included the filtering of air at the prevailing temperatures, and subsequently, the cooling of air with ice, water sprays or dry ice. None of these were effective.

In 1940, the Lintern Corp. introduced the first mechanical refrigeration system for installation on cranes, using an air-cooled condenser. Because of several factors, these early units were not successful on pit crane applications, where temperatures often hold at 170 F for long periods. Consequently, in 1941 we turned to a water-cooled condenser, using Freon F-12 as a refrigerant. We have since used only the Freons (F-12 and F-114) as the refrigerant, as they are non-toxic and non-corrosive. That is why they are in wide use in air-conditioning for homes and stores, and, being harmless in contact with both men and materials, for the carrying agent in insecticide bombs.

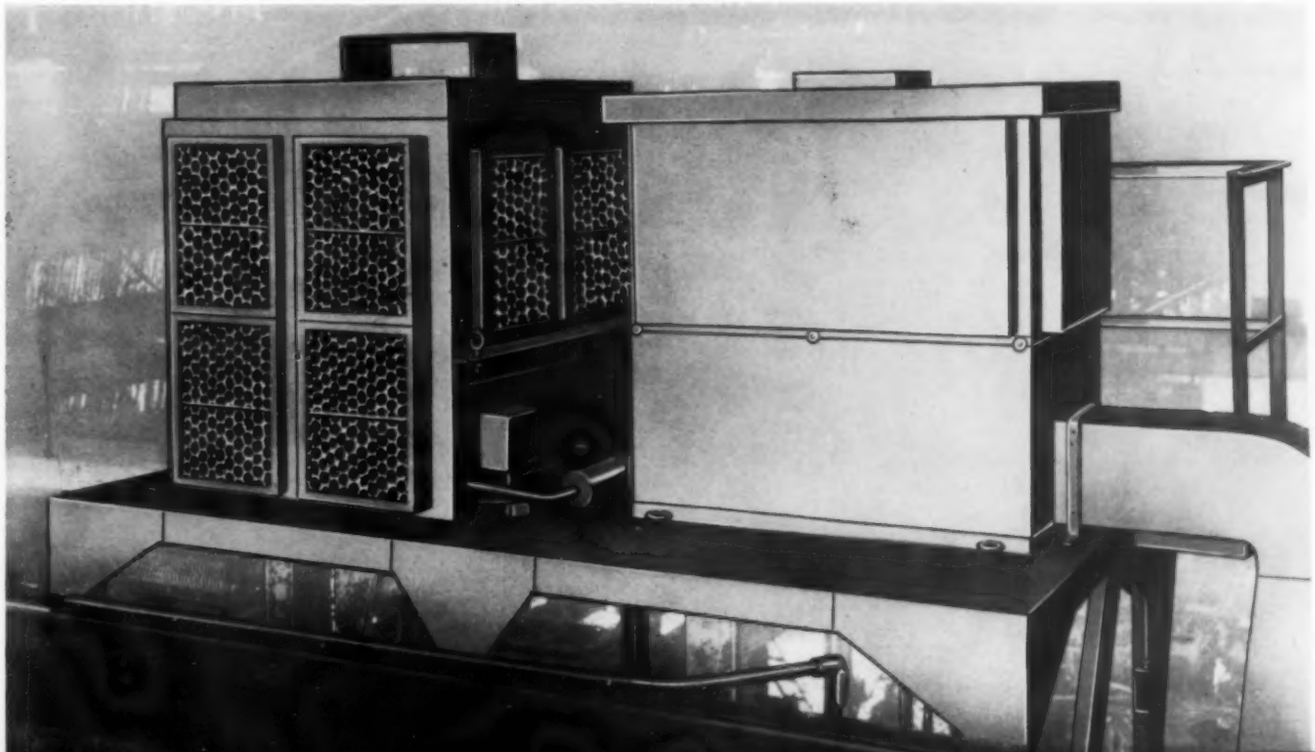
The early units were bulky and difficult to place on a crane. The water-cooled condenser required the use of sprays, pumps, storage tanks and, because of the war, galvanized steel coils, all requiring frequent service and replacement. Maintenance was high and breakdowns frequent.

Also, in those early years, we had to contend with an almost universal lack of appreciation of the need for cab and air duct insulation. Several installations were failures because such requirements were totally ignored. This situation is greatly improved as of today, although the process of education has been rather painful at times.

With the advent of the improved air-cooled unit in 1944, using all copper coils, together with added experience, users tell us maintenance has been reduced to less than 5 per cent of that required on the water-cooled machines.

Early in 1944 we designed a small air-cooled, self contained Aire-Rectifier for use with an all-glass cab for

Figure 1 — Aire-Rectifier with water-cooled condenser (1941) required special platform above foot walk. Floor area required, 28 sq ft.

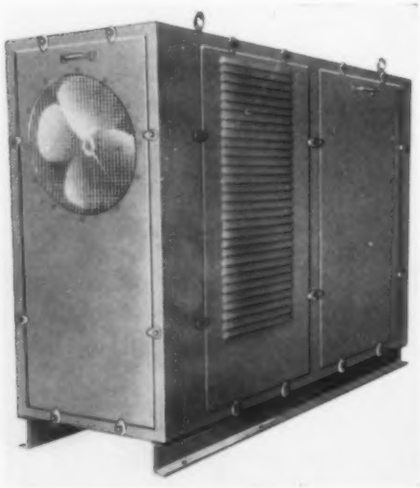


the aluminum industry. A number of these are now in use, all employing F-114 refrigerant. This was followed by a large capacity self-contained machine, with air-cooled condenser, for pit crane and other heavy duty applications. Due to the wide variation in capacity requirements, depending on the cab size and ambient temperatures in which the crane operated, a self-contained machine of 18,000 Btu per hr capacity was added to complete the line.

Our experience dictated that low compressor head pressures were necessary if the machine was to operate easily, without strain, and without motor overload at peak ambient temperatures. Special coils, designed and built in our own plant, of ample capacity, solved this problem. Consequently, Lintern Aire-Rectifiers operate at extremely low pressures. At ambient temperatures of 130 F to 140 F, 85-100 psi is usual, and at 170 F ambient temperatures, a pressure of 145 psi is normal.

Many installations have been made of the self-contained Aire-Rectifiers since they were first introduced. In applications where ambient temperatures were not extreme, say 120-140 F —and the crane arrangement permitted short ducts, the cost and loss in efficiency were not too great. However, on many pit, ladle and other cranes, including light general purpose cranes with center cabs, an extremely long duct arrangement could not be avoided.

Figure 2— Compact air-cooled condenser (1949) can be located anywhere convenient on foot walk or trolley and connected to cab unit by two refrigerant lines. Floor area required, 11 sq. ft.



More than two years ago, in an attempt to reduce overall cost and increase efficiency in the cab without going to extremes on machine size, a so-called split system was installed at a mill in the Chicago district. The condenser section was located high on the crane, and the cooling or evaporator coil in the cab. The two were then connected by refrigerant lines. Results were very satisfactory and several more installations were made.

Greater efficiency was immediately apparent with this system, since the exposed area offered by the refrigerant lines between the condenser unit and the crane cab amounts to only about five per cent of the exposed area set up by air ducts on a comparable installation. Refrigerant lines were left uninsulated, and then later insulated with no apparent change in efficiency. Since the relatively small refrigerant lines may be easily located so as to be protected from radiant heat, no increase in compressor head pressure is encountered above those previously mentioned for the self-contained unit.

Separation of the conditioning system into two parts gives flexibility in locating the equipment without penalizing performance, and it permits improved weight distribution, which is particularly important on light cranes. Shifting of other equipment to make room for the conditioning unit is no longer necessary.

Inspection is made more convenient for the service man by separation of the units, since the condenser may be placed high on the crane, away from radiant heat, while the air filters and cooling coil are grouped compactly in the cab. The protection afforded this latter equipment by the cool cab actually reduces inspection requirements and maintains high efficiency.

As a result of this experience, late in 1948 we announced the so-called split system Aire-Rectifier, in three capacities. Since that time, we have found it a favored application for lowest overall cost on all types of cranes.

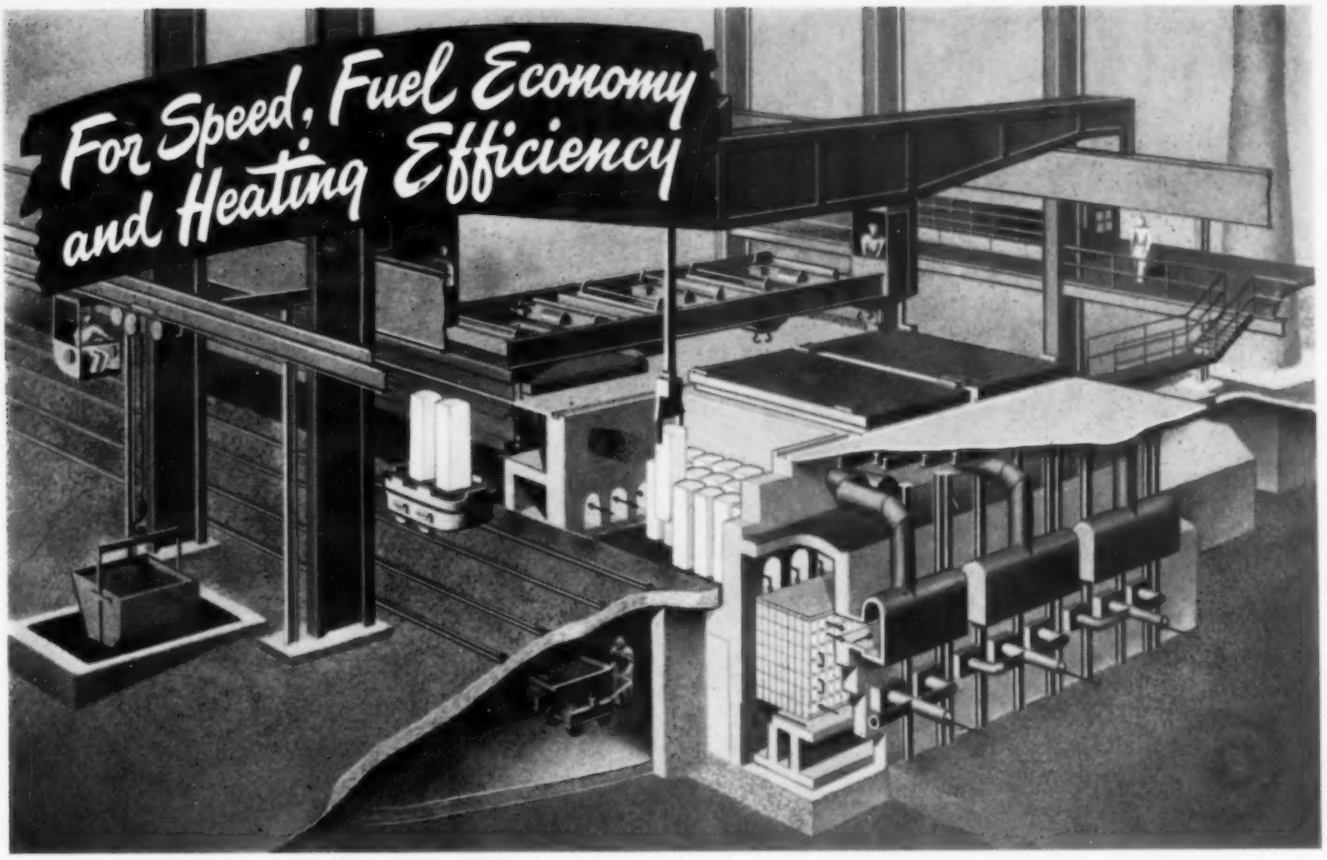
Experience has also shown the desirability of having a competent engineer connect the refrigerant lines and put the machine into service, and this service is supplied with every system. However, we have found plant maintenance men, after some instruction and study of the service manual provided, to be very capable of carrying out the few service procedures required.

Figure 3 — Cab unit (1949) includes filters, cooling and heating coils, with outside air connections. Floor area required, 3 sq ft.

Summing up the situation after ten years of pioneering and development, air conditioning can now be applied to any crane exposed to excessive heat, gases, dust and fumes, at relatively low overall cost. Machines are available having low maintenance requirements, long life expectancy and completely satisfactory performance.

The advantage of providing normal working conditions has been proven too many times to be ignored by progressive management. In every case, appreciation by the operator is reflected in better crane operation and improved personnel relations. With total installation cost, and crane downtime reduced, the capital investment has, on many installations, been returned within a period of a summer season.

The development of satisfactory crane cab air conditioning would have been impossible without the cooperation of the men of the steel industry. It is the type of equipment that can only be proven in the heat of the summer, in actual mill operation. We have learned the most important requirements through our continuous contacts with maintenance men and engineers, and we have succeeded only because of the patience of the executive engineers and management. The crane builders also have cooperated throughout in the development of satisfactory cab construction.



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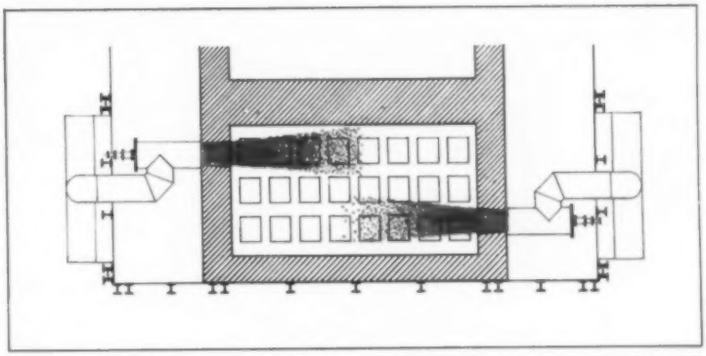

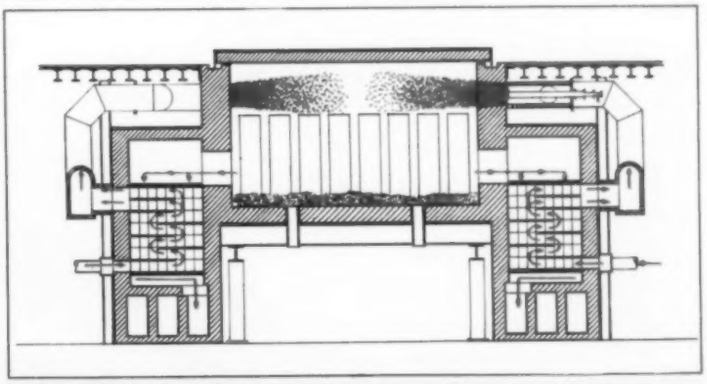

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Ronald G. Thring, *Electrical Engineer*
Capital Transit Co., Washington, D. C.

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Their cost is surprisingly low.

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Fusetron DUAL-ELEMENT Fuses

with their

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

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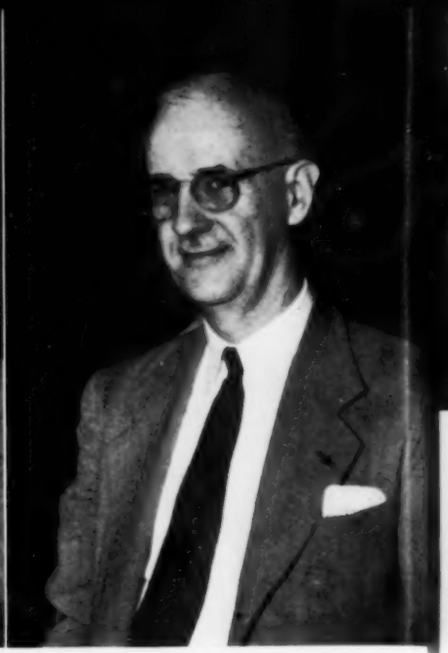
A



B

AISE *Spring Conference - 1949*

BALTIMORE, MARYLAND

▲ The 1949 Annual Spring Conference which is sponsored by the Rolling Mill Section of the AISE was one of the most successful in the history of the Association. The conference, which was held on May 2 and 3 at the Lord Baltimore Hotel, Baltimore, Md., featured technical sessions in the morning and an inspection trip each afternoon. Shown in (A) is the registration lineup on Monday morning. The first man to register was Ike Tull, (B) Republic Steel Corporation's genial electrical superintendent. He thus continues a habit of long standing. On the bottom of this page (C) Edward C. Peterson is shown presenting his paper on "New Rod Mill for Rolling Stainless Steels at Rustless" before a full house at one of the technical sessions. In (D) are shown the authors and chairmen for the rolling mill session on Monday morning. They are left to right Messrs. Lewis W. King, James N. Imel, William Herman, F. R. Burt, Edward C. Peterson and Ross Beynon. Mr. Imel and Mr. Beynon were chairmen, the others presented papers. Authors and chairmen of the electrical session are shown in (E) and they are from left to right H. H. Angel, (chairman), H. W. Bartling, Roscoe E. Marrs, A. D. Howry (chairman) and F. O. Schnure.

A banquet was held on Monday night attended by 750 members and their guests. The banquet was ad-

C

D

E

dressed by Stewart J. Cort, vice president operations, Bethlehem Steel Co. One of the features of this banquet was a presentation to Mr. Cort of an honorary life membership in the Association of Iron and Steel Engineers by C. H. Williams, president AISE. Shown in (F) are John D. Young, vice president in charge engineering, National Tube Co., Stewart J. Cort, C. E. Clarke, general manager, Sparrows Point plant, C. H. Williams, president AISE and chief engineer, Carnegie-Illinois Steel Corp. Shown in (G) are W. S. Hall, a former president of the AISE, C. H. Williams and J. M. Sylvester, general manager, Bethlehem plant, Bethlehem Steel Co. Shown in (H) at bottom of page is a portion of the group who visited the Sparrows Point plant of the Bethlehem Steel Co. on Tuesday afternoon. Thirteen buses with 593 passengers traveled the interesting route which had been laid out by F. O. Schnure, electrical superintendent, Sparrows Point plant, and Louis F. Coffin, superintendent mechanical department. Among the interesting features of this trip was a completely new and modern power station and the new 68 in. hot strip mill. In addition "H" furnace, which holds the world's record with a production of 54,336 net tons of pig iron in one month, December, 1948, met with special interest.

F

On Monday afternoon, the group visited the Rustless Iron and Steel Division plant of the Armco Steel Corp. in Baltimore. One of the features of this trip was a new high-speed rod mill for stainless steel which was described in two papers at the Monday morning session. Eleven buses with 487 passengers made the trip.

G

H

Iron Ore Conditioning and Sintering*

By FRANCIS H. CROCKARD
Product Control Engineer
Ore Conditioning Plant
Tennessee Coal, Iron and Railroad Co.
Fairfield, Ala.

▲ Various iron ores for blast-furnace use, each of fairly uniform composition, originating presently in eight underground mines, are crushed, screened to three sizes, and blended to a uniform excess acidity in the central ore conditioning and sintering plant of Tennessee Coal, Iron and Railroad Co., near Birmingham, Ala. Excess acidity is considered the silica plus the alumina, minus the lime. Ore blending keeps changes of fluxing requirements at the furnaces to a minimum. The coarse and medium size ores are shipped directly to the furnaces and the fine size is sintered before shipment. Some local strip-mine brown ore, washed in log washers, and high grade ores from Brazil and Sweden, are also blended at the ore plant.

CRUSHING AND SCREENING PRACTICE

The ore is brought to the conditioning plant in 70-ton ore dump cars. A shift production from a given mine is handled as a unit, all belts being cleared before ore from another mine is dumped.

The ore is brought to the conditioning plant in 70-ton ore dump cars. A shift production from a given mine is handled as a unit, all belts being cleared before ore from another mine is dumped.

Ore is dumped two cars at a time in a rotary dump. The ore from each car feeds to one of two 42-in. gyratory crushers set at 5 in. on the close side. Each crusher discharges to a separate belt, which takes the ore to one of two surge bins, each of which feeds two 7-in. cone crushers set at approximately ¾-in. on the close side. Scalping screens before each of the four secondary crushers remove the plus 2½-in. material, which is passed over a picking belt for removal of tramp iron, wood and slate before going to the crushers.

All of the ore from the four secondary crushers is discharged to one belt which transports it to a large surge bin at the top of the screening building. A conveyor scale on this belt weighs the ore and determines the ore production.

As the ore is discharged into the surge bin at the screening building, it is separated into six pockets by dividing plates and baffles. Ore from each pocket is fed by vibrating feeders to one of 6-ft by 14-ft double-deck vibrating screens, arranged in two parallel banks of three screens each. The top deck screens are $^{13}/_{16}$-in. square opening and the oversize from this screen is "coarse ore." The bottom deck has ¼-in. square openings, and the oversize from this screen is the "medium ore." The minus ¼-in. material is fine ore for the sintering plant. Conveyor scales weigh the three products and furnish a check against the total weight already obtained. About 55 per cent of the ore that has gone through the secondary crushers is plus $^{13}/_{16}$-in., or coarse ore. Medium ore is about 25 per cent, and fine ore 20 per cent.

The coarse ore is taken by belt out one side of the building, thence to the top of the coarse silos, where it is discharged by a movable tripper into the silo designated for that particular ore. Medium ore is handled in the same manner out the other side of the building to the medium silos. Fine ore is taken by belts to the sinter plant, where it is discharged to its proper bins.

The entire crushing sequence, from the rotary dump to the top of the silos and the bins, is controlled from one room and is so interlocked that should one unit in the sequence stop, all units before it also stop, but the rest of the system will continue to operate. Time delays allow the secondary crushers to clear themselves.

BLENDING OF COARSE AND MEDIUM ORES

The procedure for blending either coarse or medium ores is the same, so the procedure for coarse ore only will be described.

The 20 silos in two rows for coarse ore are divided into groups of four, each of the four silos discharging to the same proportional feeder. The discharge gates are interlocked so that ore may be withdrawn from only one silo at a time in a given group. The ore flows into a hopper under which is a vibrating feeder, which feeds to a weigh belt. There are five of these proportional feeders for the silos, so as many as five ores may be used in a given blend. The five feeders discharge to the same belt, and the ore is mixed when it transfers to another belt and as it discharges to a receiving hopper and the railroad cars.

Separate belts and loading facilities are provided for coarse and medium ore, so that both kinds may be loaded simultaneously. Conveyor scales on these belts record the total tonnage of each size that is loaded out.

During the past year, new storage facilities have been installed back of the silos. Instead of discharging the ore into a silo, it is discharged onto an overhead belt which has an oscillating tripper that spreads the ore in a thin stream back and forth over the length of the pile. Reclaiming is done

*Condensation of a paper presented before a meeting of the National Blast Furnace and Raw Materials Committee of the American Institute of Mining and Metallurgical Engineers, in Chicago, Ill., April 20, 1949.

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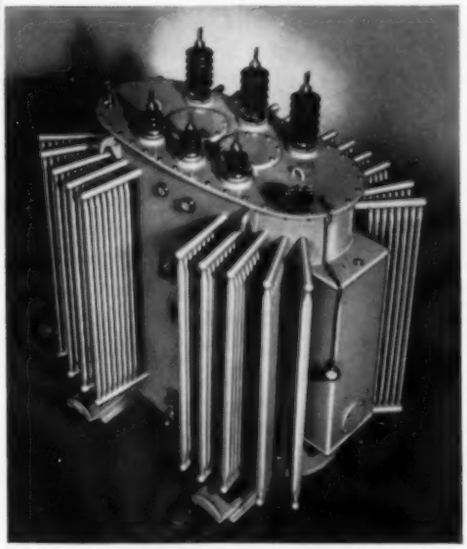
Pennsylvania STANDARD PARTS POWER TRANSFORMERS



The use of standard designs and parts shorten engineering and production time to give you lower prices and faster deliveries.

That's right! The economies we realize in manufacturing Standard Parts Power Transformers are passed on to you in the form of lower prices (prices are 4% to 6% less than conventional transformers) and faster deliveries. Pennsylvania Standard Parts Power Transformers permit limited variations, both in parts and in electrical characteristics, to meet a wider range of system requirements. It will pay you to look into this line of Power Transformers which provides the desirable features of custom built transformers at quantity production prices.

Auxiliary compartments, welded to each end of the transformer and connected to each other and to the main tank, form the following oil preservation systems:

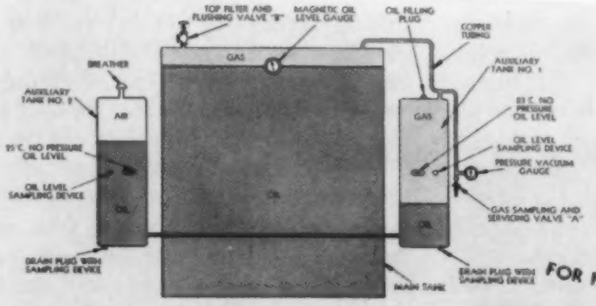
Inert Gas-Oil Seal

Sealed Tank

Inert Gas Pressure System

All Standard Parts Power Transformer tanks, regardless of the type of oil preservation, are filled with the same quantity of oil, with the extra gas and oil spaces provided in the auxiliary tanks. Bushings with standard length shanks are used on all Standard Parts Transformers, and no special-size bushings need be stocked. This permits the user to change the method of oil preservation from Sealed Tank to Inert Gas-Oil Seal; and from Inert Gas Pressure System to Inert Gas-Oil Seal or Sealed Tank.

PREFERRED VOLTAGES AND BAND OF RATED VOLTAGES	
PREFERRED HIGH VOLTAGES	RANGE OF RATED HIGH VOLTAGES LINE TO LINE
2400	.....
4800	.....
6900 7200	6600 to 9050
12000 13200 13800	11000 to 14750
22900	21500 to 24600
26400 34400	26400 to 36200
43800	42000 to 46000
67000	63000 to 69000



DIAGRAMMATIC DRAWING OF INERT GAS-OIL SEAL SYSTEM

Pennsylvania
TRANSFORMER COMPANY
PITTSBURGH 12, PENNSYLVANIA

FOR FURTHER INFORMATION Pennsylvania TRANSFORMERS WRITE FOR BOOKLET NO. 1492

through gates in a tunnel under the pile, the ore feeding onto belts which discharge to the regular loading out belts.

SINTERING

The sinter bins building has three rows of bins, each bin having a live storage capacity of about 320 tons of red ore. There are 16 bins in the first row, and fine ore brought by belt from the screening plant is placed in its assigned bin depending upon the mine from which it comes.

The second row of 10 bins is for material from outside the plant, such as flue dust, coke, coal, or stock-pile fine ore which is unloaded at a track hopper. A hammer mill and double deck screen are provided so that some preparation may be given such material; or it may be by-passed directly to the bins.

The third row of 7 bins is used normally for ore from the screening plant, just as the first row is, but material from the track hopper may be put in this row also, if necessary, by means of a cross belt.

Each bin is provided with an apron feeder. A given blend in the sinter plant is not limited to five ores as in the ore plant, but, for operating reasons, most blends do not contain over this amount.

Belts under each row of bins convey the material to the end of the building, where they discharge to a cross conveyor to go to the sinter plant proper.

In the sinter plant building, vibrating conveyors bring the returns from the discharge grizzlies to the feed belt, the feed material protecting the belt from the hot returns. The feed is then taken by belt to a super hopper in the upper part of the building, where it is divided three ways. This is done by a revolving spout which gives a full flow of the material momentarily to each compartment. Vibrating feeders feed the three revolving barrel-type pug mills, one for each sintering machine. Final water is added at the pug mills by spray controlled from the operating floor. Belts take the feed from the pug mills to the sinter machines, where it is distributed on the grates by conventional swinging spouts.

Each of the sintering machines is 72 in. wide. One is a 14-windbox machine, 89 ft, 3 in. long, and the other two are 16-windbox machines, 102 ft long. Ignition is by natural gas. The machines discharge over grizzlies, and the outside chute are curved so that all three machines load into the same car. Sinter is water quenched both in the chutes and in the cars.

"Turbo-Hearth" Steel Method

COMBINES BENEFITS OF BESSEMER AND OPEN HEARTH

▲ Basic principles for making steel rapidly in a new vessel called a "turbo-hearth" have been established by pooling the research of two major steel producers. The new method, say its sponsors, will permit the manufacture of steel of open hearth quality, low in phosphorus and nitrogen, by directing jets of air across the surface of white-hot liquid pig iron.

Announcement of this new American development was made recently by spokesmen of the two collaborating units—Dr. E. C. Bain, vice president, for Carnegie-Illinois Steel Corp., and H. W. Graham, vice president, for Jones & Laughlin Steel Corp., both of Pittsburgh, Pa. Credit also was given to C. E. Sims, of Battelle Memorial Institute, Columbus, Ohio, who assisted Carnegie-Illinois with research proposals. "The metallurgical feasibility of the process has been demonstrated," Dr. Bain and Mr. Graham asserted, "by the results of preliminary tests using small-scale units, these tests providing sufficient background for the design and construction of a full-sized furnace in which operating problems may be studied experimentally."

The turbo-hearth was developed, its sponsors explained, in an attempt to combine the advantages of the basic open hearth and acid Bessemer processes, the two leading methods followed by steelmakers in the United States. Turbo-hearth steel is made in a partly closed, side-blown vessel, lined with refractory similar to that used in the Thomas basic bessemer process.

The brick lining of the vessel is magnesia rather than silica. As in the bessemer process generally, heat is supplied by chemical reaction of the blown air with carbon and other elements of the charge. Chemical action is fast and direct, but subject to controlled conditions which reduce the nitrogen and phosphorus contents, making turbo-hearth steel comparable to open hearth steel, hence suitable for more general use than the customary bessemer steel.

"The acid bessemer and the basic Thomas processes have an advantage over other steelmaking processes," the joint announcement said, "in that neither requires fuel from external sources. The choice between them depends upon the relative silicon and phosphorus contents of the iron that can be made from available ores. The reactions between the oxygen of the blast and the several elements in the liquid iron charge supply enough heat units to produce steel with sufficiently high temperature for subsequent finishing and teeming.

"The high-silicon iron used in the bessemer converter and the high-phosphorus iron in the Thomas operation are required largely because carbon, the predominating heat-producing element in the charge, is not completely utilized. Combustion of the carbon in the vessel proceeds only to the carbon monoxide stage, so that two-thirds of the potential heat from the combustion of carbon is lost when the monoxide burns to carbon dioxide in the air outside the vessel. Conservation of this heat has been practiced for years by producers of small, intricate castings. This has been accomplished with low-phosphorus iron and

without excessive silicon by introducing the air at the side or on the surface of the converter charge in such a manner that sufficient oxygen is available to burn carbon to carbon dioxide inside the vessel.

"These facts suggested that it should be possible, by directing jets of air on the surface of liquid iron to utilize the extra heat from the more complete combustion of carbon to produce steel from American basic pig iron. The turbulence created by the impinging air could be expected to accelerate greatly the refining reactions."

Possible applications for such a process, asserted its sponsors, would be: (1) The production of low-nitrogen steel in an acid-lined vessel; (2) The utilization of conserved heat to melt larger amounts of scrap, and (3) The use of a basic lining for producing steel low in both phosphorus and nitrogen contents.

Jones & Laughlin research in the first two of these three phases had progressed so far that in 1942 a specially designed acid-lined, side-blown converter of 3½ tons was installed at the Aliquippa, Pa., works. Approximately 200 blows were produced and a large percentage of the ingots converted to commercial products. The consistently low nitrogen content and favorable metallurgical properties of the steel were sufficiently promising to warrant construction of a full-scale converter as a next step. Accordingly, a vessel of 22 tons capacity was built. Initial trial was delayed by the war, but late in 1946, the acid-lined vessel produced a number of blows for both duplex metal and steel ingots.

Carnegie-Illinois technologists approached the third problem—that of making low-nitrogen, low-phosphorus steel of open hearth quality from pig iron of a composition normally used in the basic open hearth. With the benefit of technical proposals of Battelle Memorial Institute a cooperative project was inaugurated to develop the possibilities of this process. This was done by directing jets of air on the pig iron bath in a basic-lined vessel.

A turbo-hearth of 1,000-lb capacity was built at Battelle Institute with special facilities for making temperature measurements and taking samples of slag, metal and gases without interfering with operation. A sufficient number of trials were made in 1947 and 1948 to establish basic operating and metallurgical characteristics of the new process.

In the course of the development work the interest of Carnegie-Illinois and of Jones & Laughlin converged and they conducted further research on a joint basis. Encouraging results obtained with the small turbo-hearth and availability of the Jones & Laughlin commercial-size unit led to the installation and relining of the latter with basic refractories last year at South works of Carnegie-Illinois in Chicago. The larger vessel performed as expected.

Operating difficulties such as are generally associated with the development of a new process have not yet been completely overcome, the sponsors said. Experience gained during this work, however, has shown to their satisfaction that the turbo-hearth process is fundamentally sound and that operating problems are not insurmountable.

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Date-line Diary...

April 1

▲ Over 85,000,000 gross tons of Lake Superior iron ore are expected to be carried to lower lake ports this season.

▲ Gasoline prices were increased about a half cent a gal today in the New York and New England areas.

▲ Lead prices were cut 1 cent to 16 cents a lb.

▲ Republic Steel Corp.'s new 40-oven coke battery at Warren went into production. Work is also being started to dismantle another old battery to make room for an additional 40-oven battery.

April 2

▲ No. 2 heavy melting scrap prices were cut in Buffalo from $28.00 to $22.00 a ton.

April 3

▲ The Ford Motor Co. reduced prices of cars from $12.00 to $30.00 and trucks up to 2 per cent.

April 4

▲ Based on reports of companies having 94 per cent of the steel capacity of the industry, the operating rate of the steel industry is scheduled at 98.8 per cent of capacity for the week beginning April 4, 1949. This is equivalent to 1,821,400 tons of steel ingots and castings compared with 1,839,800 tons one week ago.

April 5

▲ American Railway Car Institute announced that domestic freight car deliveries during March were 11,882. Orders during March were for a total of 469 cars.

▲ Prices of No. 2 heavy melting scrap in Pittsburgh today broke to $25.00 a ton.

▲ The Securities Exchange Commission reported that United States citizens saved $4,900,000,000 in 1948. This was the lowest since 1940.

▲ St. Joseph Lead Co. cut lead prices 1 cent to 15.8 cents a lb at St. Louis.

▲ The Bureau of Mines reported today there are 12,000,000 tons of metallic manganese in South Dakota, but at the present time this is too expensive to mine.

April 6

▲ The Inland Steel Co. today reduced steel prices 30 cents per 100 lb for its steel rails for new price of $3.20 per 100 lb at its works.

▲ The Pittsburgh Steel Co. decided to close one of its three blast furnaces at Monessen.

▲ New construction put in place in March was $1,200,000,000 according to the Department of Commerce. This is 9 per cent higher than February and 2 per cent higher than the same month one year ago.

▲ The Stacey Dresser Engineering Division announced today successful completion of initial test runs on its new plant for low cost extraction of oxygen from the air. This plant is now producing more than 175 tons per day of 90 to 95 per cent pure oxygen. Production cost is said to be about $5.00 a ton at the plant which is located in Winshire, Texas and uses natural gas as a fuel.

▲ Carnegie-Illinois Steel Corp. and National Tube Co. made adjustments in prices of galvanized products because of the cut in the price of zinc.

▲ The Federal Security Agency announced that employment in iron and steel foundries dropped nearly 5 per cent in January and February of this year.

April 7

▲ Colorado Fuel and Iron Corp. reduced prices of rails $4.00 a ton to $66.00 at its Minnequa Works in Colorado.

▲ CIO Steel Workers announced that 4480 union members have been laid off in the Chicago area since January 1st.

▲ Edwin G. Nourse, chairman of the President's Council of Economic Advisers, predicted higher taxes or deficit spending are inevitable if we have to add the cost of arming North Atlantic Pact countries onto our present budget.

April 8

▲ American Iron and Steel Institute announced that the February payroll of the iron and steel industry was $189,751,000 for the highest record for that particular month. Employment set a post-war record of 652,800 for an increase of 2,600 persons over January. Average earnings were $1.696 compared with $1.712 in January.

▲ Secretary of Agriculture Brannon presented a radically new farm subsidy program to Congress. The plan eliminates the parity price system and provides a formula which sets a total farm cash income goal.

▲ Loans to business by New York City Banks dropped $116,000,000 in the week ending April 6th.

▲ Freight car loadings for the week which ended April 2, were 725,623 cars and were higher than the levels for 1948 and 1947 for the first time this year. This figure is 9.8 per cent higher than one year ago.

April 9

▲ The F. W. Dodge Corp. reported that contracts awarded in the first quarter in the thirty-seven states east of the Rocky Mountains declined 9 per cent compared with the corresponding period of one year ago.

April 10

▲ Automobile output last week set a new postwar record of 130,197 units according to Ward's automotive reports.

April 11

▲ The Economic Cooperation Administration announced that steel production in Europe in 1948 was about 40,000,000 metric tons or 30 per cent more than in 1947. The program outlined by the ECA will provide finished steel production of about 44,300,000 tons by 1953. Total investment to be made in production facilities is about $3,100,000,000.

▲ Based on reports of companies having 94 per cent of the steel capacity of the industry, the operating rate of the industry for the week beginning April 11, 1949 is 99.2 per cent of capacity, equivalent to 1,828,800 tons compared with 1,821,400 tons one week ago.

April 12

▲ Walter S. Tower, president American Iron and Steel Institute, stated in an address that the steel shortage has disappeared and supply is no longer a problem to most steel consumers.

▲ N. B. Randolph, vice president Granite City Steel Co., told the American Zinc Institute that steel demand was softening except for galvanized sheet.

▲ The Presidential Fact Finding Board turned down the demands of the railroad unions for an extra engineer on diesel locomotives.

▲ The American Iron and Steel Institute announced that in the first quarter of this year, production of raw steel was the greatest in history with a total of 24,053,181 tons. March production set a new record of 8,388,965 tons with furnaces being operated at 102.7 per cent capacity.

April 14

▲ Secretary of Commerce Sawyer announced that voluntary steel allocations in July will be reduced by 17,171 tons from the June figure to a figure of 272,244 tons in July.

April 15

▲ No. 1 heavy melting scrap in Pittsburgh dropped $2.00 to $25.00 a ton.

April 16

▲ Granite City Steel Co. is starting construction of a $1,500,000 open hearth furnace which will have an annual capacity of 100,000 to 125,000 ingot tons.

April 18

▲ The Lukens Steel Co. reduced prices of carbon steel plates $5.00 a ton to a new base price of $70.00 a ton fob Coatesville.

▲ The Allegheny Ludlum Steel Corp. revised downward the base price of transformer grade "C" steel from $10.05 per 100 lb to $8.05 per 100 lb.

▲ Based on reports from companies having 94 per cent of capacity of the industry, the operating rate of the steel industry is scheduled to be 98.4 per cent of capacity for the week beginning

April 18, 1949. This is equivalent to 1,814,000 tons compared with 1,828,800 tons one week ago.

▲ The General Motors Corp. reduced diesel-electric locomotive prices 5 per cent.

▲ According to Engineering News record, construction costs dropped 1.4 per cent during the six months ending April 14th. Construction costs, however, are still 7 per cent above Mid-April, 1948.

▲ Pittsburgh Steel Co. is closing down its second blast furnace in three days. Because of lower scrap prices they are able to use larger quantities of scrap thus reducing demand for pig iron.

April 19

▲ The CIO United Steel Workers is expected to ask for wage increase and social security and retirement benefits which will add 23 cents more to hourly wage costs.

April 20

▲ Effective today, Kaiser Co. announced that it will effect certain freight allowances on some of their products shipped to destinations within their marketing areas.

April 21

▲ The Allegheny Ludlum Steel Corp. laid off 700 employees at its Brackenridge plant. This amounts to 10-11 per cent of its total payroll.

▲ Republic Steel Corp. shut down its fourth open hearth furnace at the Massillon plant.

April 22

▲ David J. McDonald, international secretary-treasurer of the CIO steel workers union, predicted that they will win wage boosts this year.

▲ Alan Wood Steel Co. reported its net income for the first quarter is $1,385,687 or $2.68 a share after preferred dividends. This compares with $1.21 one year ago. Net sales were $13,815,257 compared with $11,372,954 in the first quarter of 1948.

April 23

▲ Ward's automotive reported that current truck production set a new record this week of 135,598 units.

▲ The price of crude oil in the middle east was reduced by 15 cents a bbl.

April 24

▲ Federal Security Agency stated that unemployment payments for the week ending March 5th, were paid to 1,971,000 workers or 28,000 fewer workers than for the week ending March 5th.

April 25

▲ Exports of iron and steel products in 1948 decreased 2,196,000 net tons or 35 per cent from the previous year. A total of 4,680,000 tons was exported in 1948. European production was higher, however, than the previous year.

▲ The Armco Steel Corp. announced that net earnings for the first quarter of 1949 were $8,621,791 or $2.15 per share after preferred dividends.

▲ Based on companies having 94 per cent of capacity of the steel industry, the operating rate is scheduled to be 97.5 per cent of capacity for the week beginning April 25. This is equivalent to 1,797,400 tons compared with 1,814,000 tons one week ago.

April 26

▲ Youngstown Sheet and Tube Co. reported that net earnings for the first quarter of this year were $10,022,660 compared with $6,423,566 for the same period in 1948. Net sales increased from the $88,033,031 last year to $106,574,356 for the first quarter this year.

▲ American Institute of Steel Construction reported that estimated bookings on fabricated structural steel for March totaled 147,637 tons, 37 per cent greater than February. Bookings for the first three months of 1949 are down 23 per cent from the corresponding months of 1948.

▲ United States Steel Corp. announced that income for the first quarter of 1949 was $49,928,670 compared with $27,857,341 in 1948.

▲ The Supreme Court upheld an order of the Federal Trade Commission which prohibited makers of rigid steel conduit from selling their products under a basing point delivered price system.

▲ Crude oil prices in East Texas dropped 25 cents a bbl. This reduction is due to the reduction in prices of heavy fuel oil over the last six months.

▲ A temporary injunction which restrained the Struthers Iron and Steel Co. from leasing its blast furnace to the General Motors Corp. was withdrawn by the minority of stockholders of Struthers. Struthers plans to lease its blast furnace to General Motors for $200,000 a year.

▲ The Jones and Laughlin Steel Corp. reported sales in the first quarter of 1949 of $116,892,730 compared with $97,531,525 for the same period in 1948. Net income was $9,868,895 or $3.84 per share compared with $1.93 per share in 1948.

April 27

▲ The Inland Steel Co. reported net sales for 1949 of $101,445,598 compared with $90,527,112. Net income for the first quarter amounted to $9,254,230 or $1.89 per share compared with $1.73 in 1948.

▲ The International Nickel Co. reported that world sales of nickel in 1948 were 240,098,274 lb compared with 205,278,868 lb in 1947. Over 90 per cent was consumed in the United States, Great Britain and Canada. The United States purchased 177,000,000 lb in 1948.

▲ Ernest T. Weir of the National Steel Corp. estimated that steel production may drop to 75 per cent of capacity by the end of the year.

▲ United Engineering and Foundry Co. reported that their backlog of orders is sufficiently high to continue production through and beyond 1949.

▲ American Iron and Steel Institute reported that 65,973,000 tons of finished steel was shipped in 1948. Of this 4,300,000 net tons went to the oil and gas industries; 10,221,000 tons went to the automotive industry; 9,971,886 tons went to jobbers and dealers; 7,623,000 tons went into construction exclusive of oil and gas; 5,225,000 tons went into railroad transportation; 1,427,000 tons went to agricultural equipment makers.

April 28

▲ Wheeling Steel Corp. stated in its report today that the demand for basic steel continues to exceed productive capacity but signs indicate that the supply of finished steel is becoming more nearly in balance with demand.

▲ Colorado Fuel and Iron Corp. reported a let-down in business, and operations at the Wickwire Spencer Steel Plant have been reduced to 75 or 80 per cent of capacity.

▲ Steel scrap prices in the Pittsburgh District dropped $1.00 to $24.00 a ton for No. 1 heavy melting scrap.

▲ The CIO United Electrical Workers are asking wage increases and security benefits which amount to $500.00 per year per employee.

▲ The Federal Reserve Board estimated industrial production in March at a 184 per cent of the 1935-39 average compared with 189 per cent in February. This decline was more than in any one month since it started to drop last autumn.

April 29

▲ The National Steel Corp. reported that net income for the first quarter of 1949 was $14,753,775 or $6.01 per share compared with $3.88 per share for the corresponding period in 1948.

▲ The Allegheny Ludlum Steel Corp. reported earnings for the first quarter of 1949 of $1,542,195 or $1.09 per share after preferred dividends. Earnings were $1.01 per share in 1948. Sales for the first quarter of 1949 were $33,233,376 compared with $27,418,144 for the first quarter of 1948.

▲ The Federal Reserve Board ordered a cut of reserve requirements for member banks.

▲ The Bethlehem Steel Co. reported earnings of $3.29 a common share compared with $1.55 a year ago.

▲ Zinc prices dropped a half cent to 12½ cents a lb at East St. Louis.

April 30

▲ The Lukens Steel Co. reported that its net income for the first two quarters in its 1949 fiscal year which ended April 16, 1949 was $2,271,705. This is equivalent to 6.4 per cent of sales compared with 2.8 per cent of sales in the same period the previous year.

▲ The Commerce Department reports that manufacturers' inventories declined in March about $300,000,000. This is the first decline since the war and is due primarily to lower prices as the actual physical quantities have changed very little.

Is PHYSICAL STRENGTH your magnet problem?

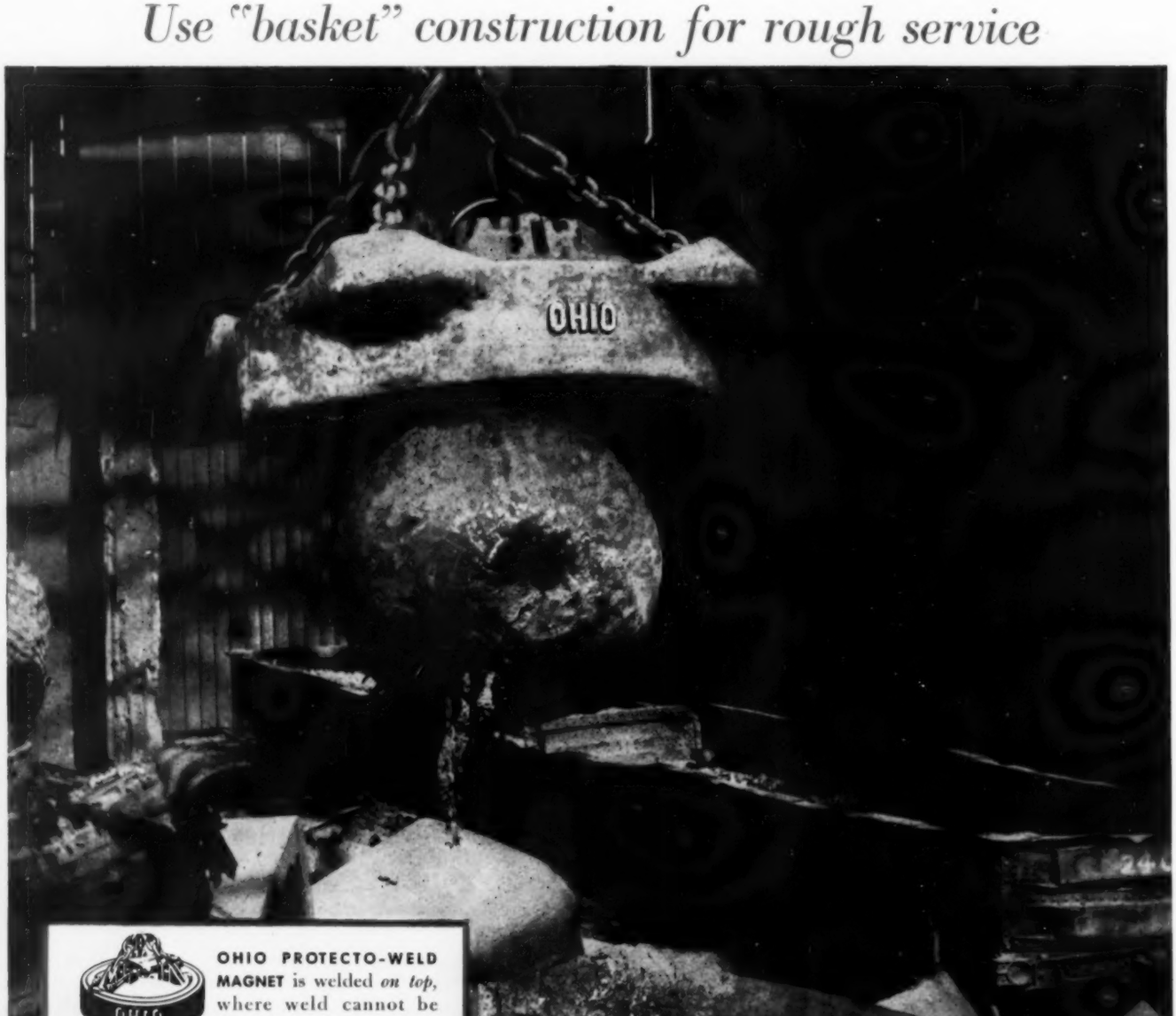
Mills agree that skull-cracking subjects a magnet to the roughest of service. Cautioning crane operators to "take it easy" is sage but frequently impractical advice.

Why not fit your magnet to the job when you buy?

Ohio *basket-type* magnets are specially constructed to withstand hard knocks. "Fenders" project beyond magnet diameter . . . stave off and protect against damaging blows.

For extra magnet life in rough service, install Ohio *basket-type* magnets. Write today to Ohio—25 years a leader in *magnetic materials handling.*

Use "basket" construction for rough service



OHIO PROTECTO-WELD MAGNET is welded *on top,* where weld cannot be dented in. Sizes include 39, 46, 55 and 65-inch diameters. Ohio also builds magnet control equipment.

THE OHIO ELECTRIC MFG. CO. • 5900 MAURICE AVENUE • CLEVELAND 4, OHIO

Ohio MAGNETS

Industry News...

FORGING AND HEAT TREATING OF SUCKER RODS USED IN OIL WELLS

▲ The speed and efficiency with which oil is pumped from a well depends largely on the strength and exactness of the sucker rods, which actuate the subsurface pumps.

Sucker rods must be capable of carrying loads up to 45,000 psi, while resisting powerful corrosive elements.

Jointed into "strings," sucker rods are used in some 400,000 wells in the United States with an average depth of 3,000 feet. These strings represent a dollar value of nearly $250,000,000, no small investment even in an industry that talks in millions. These rods are made from carbon and high-alloy steel and are precision heat-treated for maximum strength and endurance. An all-steel integral-joint rod is the basic design still in use.

Rods must be absolutely uniform in quality throughout their entire lengths and must shoulder perfectly at the connection, or joint. Under the heavy tension to which the string is subjected, the slightest defect can cause concentration of stress at that point. A break in the string will occur prematurely at the excessive stress point and lead to a costly, tedious "fishing" job.

Emphasis on quality begin with the rod stock. Only blanks of fine-grained carbon and alloy steels are used.

The exacting manufacturing process begins with forging the ends. Ends of the blanks are subjected to five separate forging operations to form full-strength pins. The least variation from specifications can weaken the pin. Blank ends are heated twice during the forging operations.

Only through precise and complete heat treatment can a rod be conditioned to meet the shock, fatigue and corrosion of present-day oil production. After the pin forging, rods are given triple heat treatment over their entire length by an exclusive process consisting of normalizing, quenching and stretch-straightening. Heating is done in special gas-fired furnaces and automatically controlled throughout by electric pyrometers.

In normalizing, rods are placed in a furnace designed to heat them over their entire lengths to a specified high temperature to create a finer, uniform grain structure. After being held at that temperature for a prescribed time they are allowed to cool in open air.

This first treatment considerably strengthens the steel. For less severe pumping service normalized rods are adequate, but for the higher pumping loads only rods with additional heat treatment are of sufficient strength.

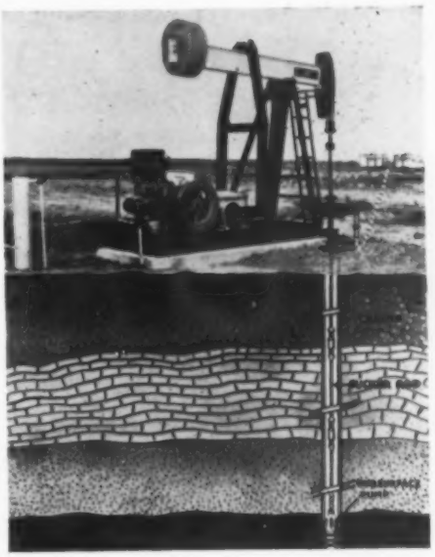
In the second heat treatment, the normalized rod is reheated to a high temperature for added strength by further reducing the grain size. At the precise instant, the rod is quickly plunged end-to-end into a quenching bath to capture the desired grain structure. Recording pyrometers govern the temperature of the steel and quenching fluid.

The same precision controls the third heating operation, the stretch-straightening, or drawing. Heated to a temperature just below that which would modify the grain structure, the rods are placed in another specially designed machine which smooths out any bends that might have occurred in the first two heat treatments then stretches each rod a fraction beyond the elastic limit to achieve perfect straightness. To retain the straightness they are held at this point under a given tension while cooling.

Simultaneously, rods are individually tested to make certain no defects have resulted from the forging and heat-treating operations.

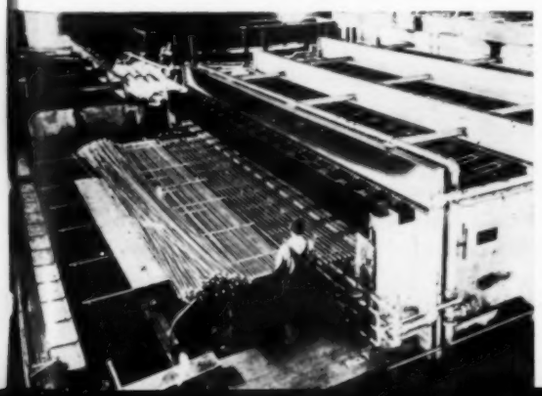
When cool, the rods are ready for threading, the final step in their production. For greatest strength in a string, pin threading must be of such accuracy that connecting joints will line up perfectly. Rods are automatically machine-threaded to American Petroleum Institute specifications. A swirling oil coolant prevents any abrupt change in temperature that would nullify the heat treatment they have undergone by altering the grain structure. With A.P.I. and special gages, threading receives closest inspection. To further insure perfect alinement when a string is made up, couplings are threaded their entire length, with a single continuous thread.

In every phase of manufacture,



The sucker rod is a slender, round section of carefully made steel which must withstand powerful corrosive elements deep below the surface of the earth and carry loads up to 45,000 psi. Jointed to form strings long enough to serve the deepest wells and powered by a surface pumping unit, the rods operate the subsurface pump which lifts oil above ground, through pipes, to storage tanks.

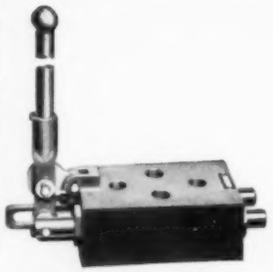
Full length normalizing is the first of three steps in the full heat-treating process which produces sucker rods of maximum strength and endurance. In this special gas furnace, rods are heated full-length to a specified high temperature which creates a finer, uniform grain structure of steel and considerably strengthens the rod.



For a maximum of long, efficient, trouble-free service

● Quick-As-Wink Valves are high quality controls designed and built to meet the most exacting requirements. All operating parts are in pressure balance eliminating any tendency to creep or crawl. The U-shaped packers are expanded by pressure and seal tightly preventing leakage. There is no lapping — no grinding — no metal-to-metal seating. Every valve is precision made and individually tested to its full pressure rating before being shipped.

Furnished in hand, foot, pilot, solenoid and diaphragm operated designs for controlling all types of air and hydraulic equipment. Let us work with you on your requirements!



Quick-As-Wink Lever Operated Hydraulic Valves

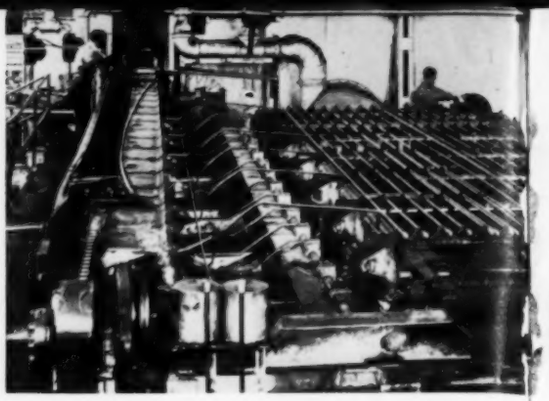
The HS-551-N4 pictured above is a neutral position 4-way valve for controlling double acting cylinders. It has a machined steel housing, chrome plated and polished stainless steel plungers, and renewable metal rings to take the impingement of the liquid flow preventing wear on the U-packers. Used for oil or water up to 3500 P.S.I. and 150° F. Other valves available for pressures up to 5000 P.S.I.; — but send for a catalog today and get *full* details about the *complete* line.

Quick-As-Wink Control Valves

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Manufactured by **C. B. HUNT & SON, Inc.,** *Salem, Ohio.*

Engineering and Sales Representatives in the Principal Cities



In the third heat treating, sucker rods are heated to a temperature just below that which would modify the grain structure, then "stretch-straightened," or drawn, in this specially designed machine which removes bends occurring during the preceding heatings and stretches the rods a fraction beyond the elastic limit to produce perfect straightness. Rods are held under a predetermined tension while cooling to retain straightness.

sucker rods are subjected to rigid inspection and samples are constantly referred for successive check to laboratories equipped to analyze physical properties of metals, run endurance tests, determine stress distribution, test shock resistance and check forging and threading.

KOPPERS CO. ACQUIRES FREYN ENGINEERING CO.

▲ Koppers Company, Inc., announced that it has contracted to purchase the Freyn Engineering Co., Chicago, Ill., one of the nation's best-known engineering firms specializing in design and construction of blast furnaces and open hearth furnaces, and in the engineering of mills, power stations, and other steel mill facilities. The acquisition also will include the Open Hearth Combustion Co., a Freyn subsidiary.

The purchase of Freyn is to be consummated through the exchange of Koppers common stock for the stock of Freyn Engineering. Freyn will continue under its present name, and for the time being will be operated as a wholly-owned subsidiary of Koppers, and there will be no changes in policies or personnel.

For many years Koppers' Engineering and Construction Division has been a leader in the design and construction of by-product coke ovens, auxiliaries, and chemical plants. The acquisition of Freyn, with its vast experience and "know-how"

in construction of blast furnaces, open-hearth furnaces, and in the engineering of mills and other facilities, now enables Koppers to provide all branches of the steel industry—both here and abroad—with design and engineering service, and, in most instances, with construction service as well.

The original Freyn organization was begun in 1914 by Henry J. Freyn, who now is retired. It was incorporated in 1917. Specializing in services to the steel industry, the firm grew rapidly. Originally it was engaged chiefly in engineering design. It entered the construction field during World War II and has since continued active in this field.

Freyn's activities may be grouped in three classes:

1. Engineering and design of iron producing plants, steel producing plants, rolling mills, and auxiliaries for iron and steel properties.

2. Contracting for the construction of new facilities or reconstruction of old facilities of the types listed above.

3. Designing and production of special equipment for steel plant use, notably for the blast furnace department. The company develops, markets, installs, and services equipment largely resulting from invention within its own organization, including blast furnace stove linings, pneumatic bell hoists, skip hoists, stove burners and boiler burners for blast furnace gas, specialized valves for furnace and stove use, primary and secondary gas cleaning equipment, and control system for sequencing blast furnace charging.

The company does not engage in manufacturing, but its patented equipment has been built under its supervision by contracting foundries and machine shops.

In addition to the large amount of work done for American firms, Freyn has executed important engineering assignments for plants located in many foreign countries.

Louis T. Shorley is president and treasurer; Gordon Fox, Bruce E. Tau, and W. B. Clemmitt, vice presidents; and E. J. Westcott, secretary. The firms offices are in the Garland Building, 109 North Wabash Ave., Chicago.

STEEL & WIRE ENGAGES WEATHER ADVISORS

▲ Guided by certain studies which show definitely that a highly unusual weather condition prevailed in the Donora, Pa., area at the time of the smog tragedy last October, the American Steel and Wire Co. has engaged the services of Weather Advisors, Inc. of Boston, Mass., to assist in efforts to anticipate the recurrence of any similar weather condition. This will permit precautionary steps to be taken by industry, railroads, river boats, and citizens generally, according to Walter O. Everling, director of research of the American Steel and Wire Co., who has been active in investigations of the October tragedy.

"The company is undertaking to perform this public service pending the conclusion of the investigation by the United States Public Health Service and any recommendation it may make," Mr. Everling said.

"Weather Advisors, Inc. is a fully accredited weather forecasting agency and has a wide reputation for

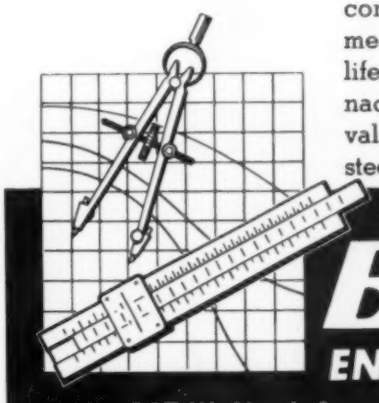
The BLOOM
TIME CYCLE REVERSAL SYSTEM

In this one compact cabinet..

ELECTRIC BRAINS that don't forget—
FINGERS that never tire

control all operations for the
FAST, AUTOMATIC REVERSAL
of open hearth furnaces!

Factory-wired, readily installed wherever convenient. Faster, smoother reversals mean greater production, longer checker life, greater fuel economy. Reverses furnace automatically on pre-set time intervals until changed. Compact, dust-proof steel cabinet.

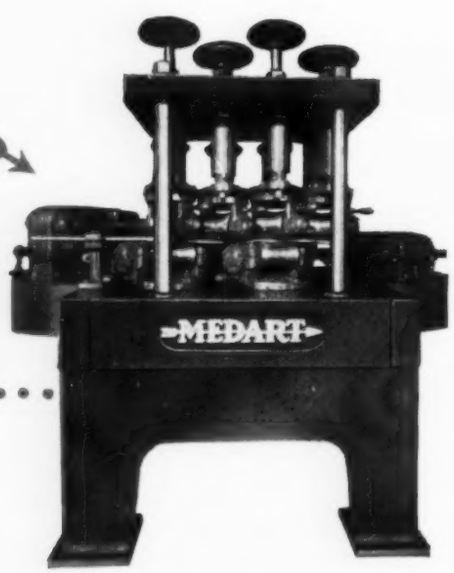


BLOOM
ENGINEERING CO., INC.
857 W. North Avenue Pittsburgh 12, Pa.

MEDART MICRO-MULTICYCLE!

straightening machine designed exclusively for ⅛" to ½" bars and tubing.

Small, compact yet built on the same principle and embodying the same advantages as the Medart 6-in-1 Multicycle Straightener . . . positive, synchronized feed . . . one feeding level . . . two bending cycles . . . single motor . . . and the Medart Micro-multicycle has this PLUS FEATURE: all six rolls are driven! A variable feed-speed range is built into the machine. 3 H. P. motor mounted on base of machine.



MANUFACTURING ENGINEERS OF COMPLETE TRANSMISSION EQUIPMENT AND SPECIALIZED MACHINERY

MEDART

THE MEDART COMPANY 3600 DE KALB ST. ST. LOUIS, MO

reliability and accuracy. It will analyze all information collected by the United States Weather Bureau since such things as a nearly stationary storm of great extent and intensity located somewhere in the Atlantic Ocean may have a profound effect upon the nature and duration of weather conditions in the entire Appalachian region of the United States. In addition it will have available daily temperature readings from Donora and the Pittsburgh airport. If studies of the general pattern indicate that it is settling into one of potentially dangerous stagnant weather conditions in the eastern United States, a first warning or alert will be furnished. A final warning will be given if observations of conditions in the vicinity of Donora indicate that the peculiar weather condition existing last October is developing and may be of more than a few hours' duration.

"Professor Hurd C. Willett of the department of meteorology of the Massachusetts Institute of Technology of Cambridge, Mass., who conducted the preliminary weather studies, will continue his investigations in an effort to add to the knowledge which has already been gained through his observations.

"This latest effort by the American Steel and Wire Co. is in line with our consistent policy of doing everything possible to determine the cause of last October's tragedy," Mr. Everling said.

LUKENS PLATE MILL TO BE ELECTRIFIED

▲ The General Electric Co. will supply more than a million dollars worth of equipment to convert to electric drive the world's largest plate mill located at Lukens Steel Co., Coatesville, Pa., it was announced recently.

The new drive will replace the 15,000-hp twin tandem cross compound steam engine now used on the 206-in., 4-high mill. Installed during the First World War, the giant mill can roll ingots up to 55 tons into the widest or thickest plates available anywhere.

The reversing motor to be supplied by G.E. will be a twin drive, with two 4000-hp, 30/75-rpm, 600-volt reversing motors; one direct connected to the top work roll and the other to the bottom work roll of the mill. The complete drive will have a continuous torque rating of 1,400,000 lb-ft

In the interest of better care for rolls, and better rolling mill production, Ol' Red will send you copies of this message for your bulletin boards. Just write—

Ol' Red Wabbler

Mackintosh-Hemphill Co.

Pittsburgh 3, Pa.

This is the first of a series, originally printed in 1941, and repeated by request. Others in this series will appear in forthcoming issues.

Ol' Red Wabbler says:

Keepin' those neck pressures and working pressures just right and equal is mighty important. You know, them big mills is kinda like you. They don't know their own strength. Remember the last time you squeezed your best gal too hard? Made you quit for the evening, didn't she.

KEEP THE NECK AND WORKING PRESSURE RIGHT

on Strip Mill Rolls—
Hot or Cold

MACKINTOSH-HEMPHILL CO.

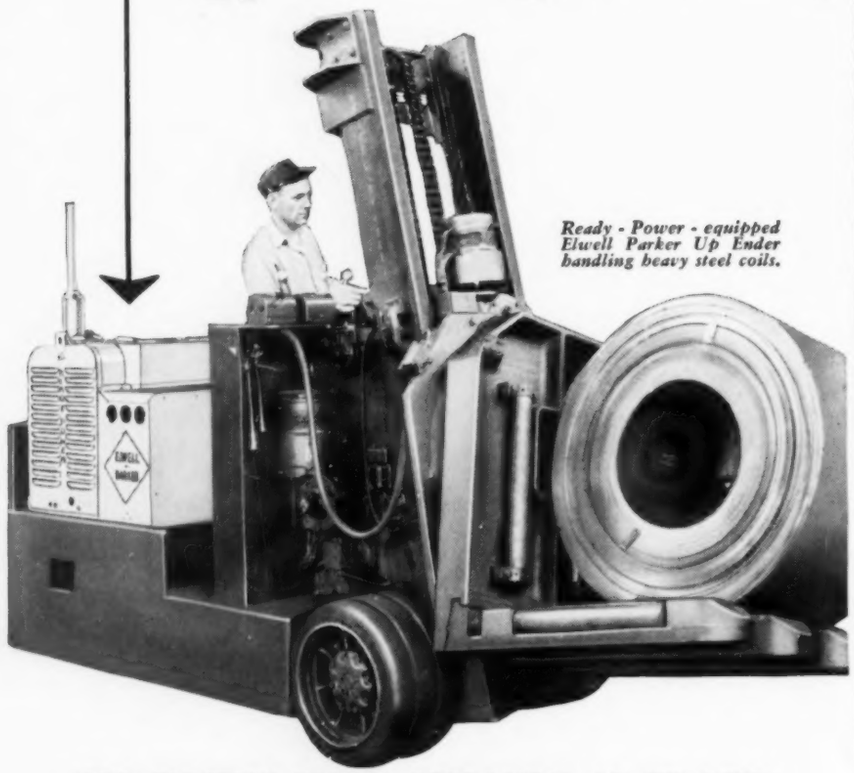
PITTSBURGH AND MIDLAND, PA.

Makers of the Rolls with the Red Wabblers

OTHER MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: Steel and special alloy castings . . . completely integrated strip mills . . . heavy duty engine lathes . . . the new Mackintosh-Abramsen straighteners . . . improved Johnston patented corrugated cinder pots and slag handling equipment . . . shape straighteners . . . shears . . . levellers.

more power

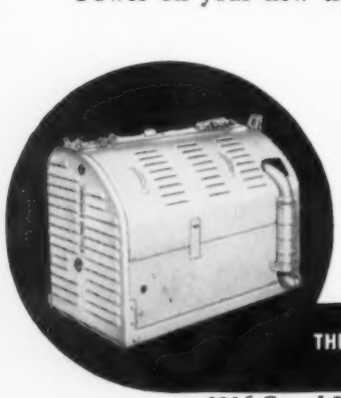
WITH **READY-POWER**



Ready - Power - equipped Elwell Parker Up Ender handling heavy steel coils.

FOR ELECTRIC TRUCK OPERATION AT ITS BEST!

Ready-Power-equipped electric trucks provide more power for heavy loads, more continuous hours of service and more materials handled in any given period. Dependable electric power is generated right on the truck chassis by an engine-driven, direct-current generator. Get the most out of your electric trucks. Convert them to Ready-Power. Specify Ready-Power on your new trucks. Write for descriptive literature.



Ready - Power - equipped Automatic Ram Trucks handling steel coils.

THE READY-POWER CO.

3836 Grand River Ave., Detroit 8, Michigan

and a maximum torque rating of 3,-850,000 lb-ft. It is the second largest steel mill drive, in torque rating, that G.E. has ever built and, it is believed, the largest twin motor drive ever built.

Power will be supplied to the reversing drive from a flywheel set consisting of four 1750-kw, 514-rpm, 600-volt generators, a 7000-hp, 13,200-volt, 3-phase, 60-cycle, wound rotor induction motor, and a 200,000-hp-seconds steel plate flywheel. The generators will have cross-connected series fields for load division, and all four will be paralleled on one bus to which both reversing motors are connected.

The control equipment supplied by G.E. will include amplidyne machines for control of generator and motor field strength, voltage maintenance, load limitation, load balance between top and bottom roll motors, and control of overshoot in speed after rapid reversal.

Other G-E equipment in the million dollar conversion includes a 13,-200-volt switchgear unit for the plate mill motor room and a 750-kva unit substation for 440-volt a-c supply.

ELECTRIC METAL GROUP TO MEET IN CHICAGO

▲ The Electric Metal Makers Guild, Inc., will hold its 17th annual meeting at the Bismarck Hotel, Chicago, Ill., on June 2, 3 and 4, 1949. A. J. Scheid, Jr., of Columbia Tool Steel Co., Chicago Heights, Ill., is president, F. O. Lemmon of Ohio Steel Foundry Co., Springfield, Ohio, is vice president and D. L. Clark of Simonds Saw and Steel Co., Lockport, N. Y., is secretary-treasurer.

The speaker at the annual banquet will be Dr. Ralph L. Lee, department of public relations, General Motors Corp., Detroit, Mich.

COKE OVEN BATTERY IS COMPLETED AT GARY

▲ Completion of the No. 16 battery of coke ovens at Gary works of Carnegie-Illinois Steel Corp. was announced recently by John H. Vohr, general superintendent of this U. S. Steel subsidiary plant. The battery includes 77 ovens, increases the

(*Please turn to page 123*)

...to Produce Greater Tonnages at Lower Cost!

You can depend on Birdsboro's Individualized Roll Service. That means Birdsboro Rolls are individually engineered to give you the specific combination of analyses and physicals to do its particular job best.

Whether your problem involves ferrous or non-ferrous metals and regardless of the degree of toughness or hardness required, Birdsboro Rolls assure you of greater tonnages, more accuracy, longer uninterrupted production and less replacement cost. On any roll problem, consult Birdsboro engineers first.

BIRDSBORO Type Rolls

*Birdsroro "30"
Birdsboro "40"
Birdsboro "50"
Birdsboro Metal
*Curoloy
Super Curoloy
Grainloy
Superloy
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FOR:

Blooming
Cogging
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BIRDSBORO
ROLLS
Steel Mill Equipment, Hydraulic Presses, Special Machinery, Crushing Machinery, Steel Castings

6 Reasons why Your Coke

Koppers-Becker Low-Differential Coke Ovens with Waste-Gas Recirculation are the most advanced ovens available and they have these advantages:

1. They make the best possible grades of domestic and metallurgical coke from suitable coals under widely-varying conditions with the least underfiring requirements, and the highest yields of byproducts.

2. They can be built (without interference with the uniformity of heating) in oven capacities up to 20 net tons of coal per oven charge, in small or large batteries, to suit local conditions.

3. They can be underfired efficiently with coke-oven gas, natural gas, blue gas, carburetted water gas, propane, butane, high-B.t.u. refinery gas, producer gas or blast-furnace gas, producing uniformly heated coke over a wide range of coking times.

4. They are built of the best materials available and of sturdiest design; are free from complications; are simple to control, and accessible throughout, insuring low maintenance cost and long life.

5. They can be operated at high speed with greater safety and at lower flue-temperatures because of the action of the waste-gas recirculation system.

6. By means of a separate and efficient blast-furnace-gas-enriching system, they can be operated to produce as much coke when underfired with low-B.t.u. blast-furnace gas as when underfired with coke-oven gas with the least requirement of high-B.t.u. coke-oven gas for enriching.

Koppers engineers will be glad to work with you on your plans for coke oven plants, light oil plants, by-product plants, gas-purification systems, gas producers, precipitators and any other equipment or apparatus connected with coal carbonization.

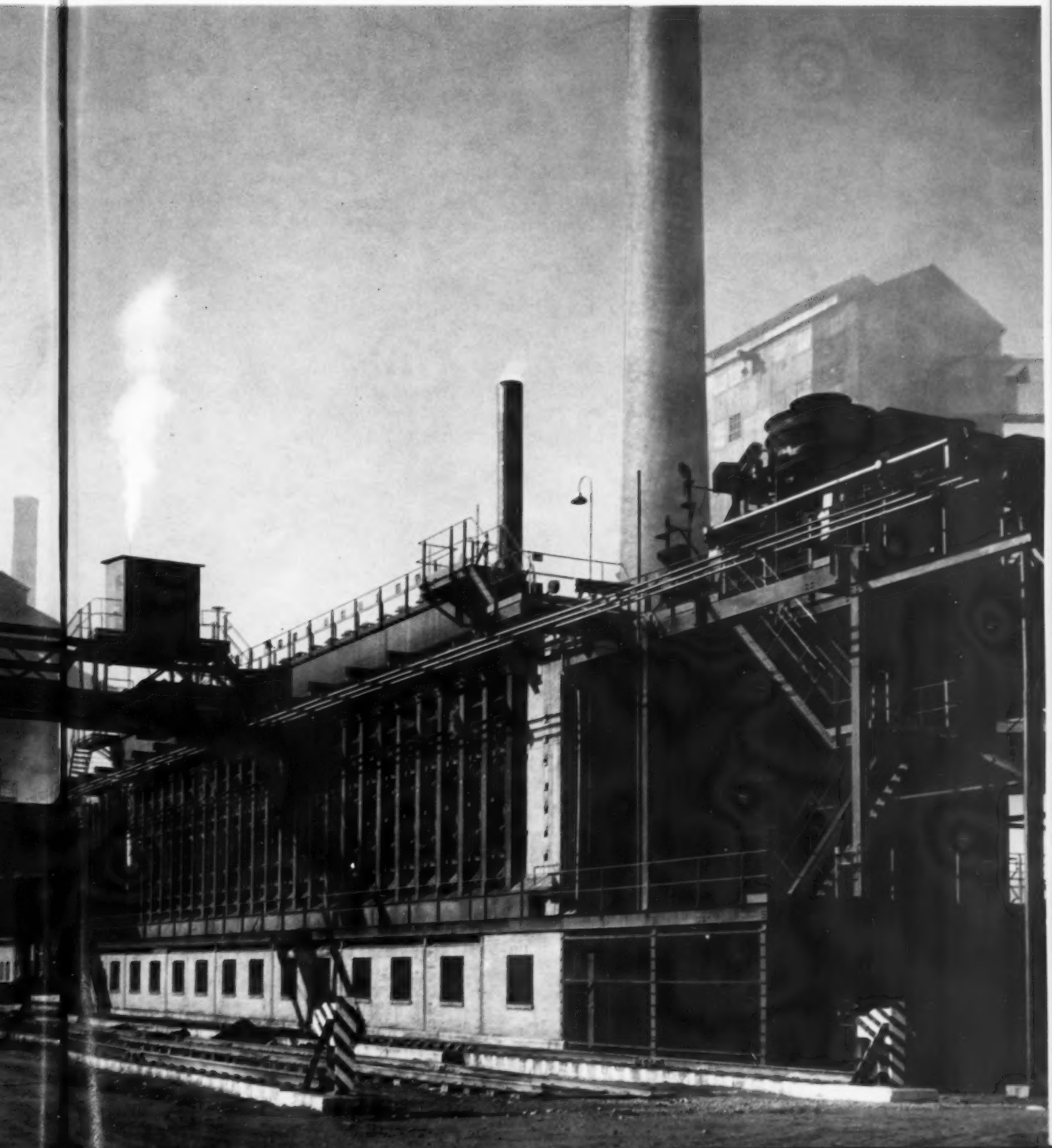
KOPPERS COMPANY, INC.

ENGINEERING AND CONSTRUCTION DIVISION

Pittsburgh 19, Pa.

KOPPERS

ke Oven Plant should be built by Koppers



SELF-CLEANING ··· WEATHER-RESISTING

KEYSTONE PORCELAIN-COVERED GIANT STRAIN INSULATORS

Here's an insulator for supporting or dead-ending cables that's proved and approved for *high flashover resistance* and *weather-resisting service*. Flashover resistance because it is self-cleaning and prevents carbon from building up on its sides. Weather-resisting because it is housed in glazed porcelain which will not crack even under extreme conditions . . . indoors or out.

The Keystone Porcelain-Covered Giant Strain Insulator contains a standard, mica-insulating, strain unit especially designed for circuits up to 750 volts. All metal parts are hot galvanized and can be furnished with two threaded studs, ⅝-inch diameter for attachment of eyes and clevises. For other applications, such as the insulator member of a third rail supporting insulator, they are supplied with two ⅝-inch tapped holes. Add to this an average tensile strength of 10,000 pounds and it can be seen why Keystone's Giant Strain Insulator is the answer when dependable insulation is required in the nation's steel mills.

Detailed information on the full line of Keystone Insulators, Rail Shoes, and Current Collectors is described in the catalog, "KEYSTONE INDUSTRIAL PRODUCTS." Write for your copy today.

ELECTRIC SERVICE MANUFACTURING CO.

1721 CAMBRIA ST. PHILADELPHIA 32, PA.

COLLECTORS · RAIL SHOES · RAIL INSULATORS · CABLE STRAIN CLAMPS · SHOP TOOLS

(*Continued from page 118*)

plant's oven total from 1,055 to 1,132 and adds daily coke output of more than 1,000 tons.

Arthur C. Wilby of Chicago, vice president of United States Steel Corp., pointed out that the initial pushing of coke from the new Gary battery marks the completion of another of U. S. Steel's post-war modernization and improvement projects in the Chicago-Gary district. Mr. Wilby said Carnegie-Illinois will have spent almost two hundred million dollars since the end of World War II and through 1949 on these projects. He added that the post-war program of Carnegie and other U. S. Steel subsidiaries in the area might well double the estimated cost.

SHEET & TUBE TO BUILD HEATING FURNACE

▲ Salem Engineering Co., is presently engineering and will build a single-fired skelp mill slab heating furnace, complete with metallic needle type recuperators, and all modern combustion, pressure, and other controls, at the Indiana Harbor plant of Youngstown Sheet and Tube Co. The unit will have a rated capacity of 80-ton per hour and is scheduled for erection during the latter part of this year.

INDUSTRIAL TRUCK FIRM COMPLETES OFFICE MOVE

▲ The Baker Industrial Truck division of Baker-Raulang Co. announces that it moved its general offices, including the purchasing, sales, engineering and service departments to 1250 West 80th St., Cleveland 2, Ohio. The division's manufacturing operations, presently located at the West 25th St. plant, will be moved to the 80th St. location within the very near future.

J&L SLAB FURNACES BUILT IN RECORD TIME

▲ Completion in record time of three slab heating furnaces for the 96 in. continuous hot strip mill of Jones & Laughlin Steel Corp., at Pittsburgh, Pa., is announced by Rust Furnace Co., the engineer constructor. The furnaces were built consecutively in 14½ weeks.

The first furnace was begun December 1 and completed January 15; the second begun January 24 and completed February 23; and the third —begun March 1—was rolling steel on March 30 after only twenty-nine days.

Total construction time is believed to have set a new record, since twelve to sixteen weeks is usually allowed for building a single strip mill furnace of this size.

The new furnaces replace three furnaces originally built by Rust in 1936. Work was scheduled so that no more than one furnace was down at any one time.

STEEL SUPPLY IS GAINING ON DEMAND

▲ Preliminary figures for the first quarter of 1949 show larger sales volume than had been expected—but new orders for steel began declining sharply during the latter part of the period, it was reported recently by William P. Snyder, Jr., chairman of Crucible Steel Co. of America.

"Supply is rapidly catching up with demand, especially in tool steels and specialty steels. It appears that peacetime competitive conditions

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Rodine®
The World's Standard Inhibitor...!

Rodine in the pickle bath—either batch or continuous—means improved pickling and lower costs because "Rodine" . . .

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"Rodine" more than pays for itself in savings of acid and metal.

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experience looms large

WHEN HEAVY INDUSTRY BUYS CONVEYING EQUIPMENT

EXPERIENCE is a big factor in the designing of conveying equipment for handling heavy materials. In that field there is no place for trial and error methods. Conveyers, like the other machinery, must be designed and built to do the job required to withstand the severe beating which conveyers must take, when applied in heavy industry.

A great part of the energy of Mathews Engineering Departments is directed to heavy industry—to handling loads weighing as much as 50,000#. Wise engineers have acquired years of experience in designing heavy Roller Conveyers, Chain Conveyers, Roller Tables, and units of special heavy conveying machinery.

Plant engineers responsible for efficient materials handling know that this experience represents real economy, and that it is the well-designed conveyer system, with the necessary weight built into it, that costs less in the long run.

The experience of Mathews Engineers, and the facilities of three modern factories are available to the steel plants, foundries, and brass mills of the United States and Canada.

MATHEWS CONVEYERS

GENERAL OFFICES . . . . . *Mathews Conveyer Company*
ELLWOOD CITY, PENNSYLVANIA

PACIFIC COAST DIVISION . . *Mathews Conveyer Company, West Coast*
SAN CARLOS, CALIFORNIA

CANADIAN DIVISION . . . . . *Mathews Conveyer Company, Ltd.*
PORT HOPE, ONTARIO

Engineering Offices or Sales Agencies in Principal American and Canadian Cities

again prevail in most lines of steel," Mr. Snyder said.

Mr. Snyder stated that "the company's $45,000,000 plant improvement program is virtually completed at Crucible plants in Syracuse, N. Y., Harrison, N. J., and Pittsburgh, Pa. The modernized and improved facilities are of considerable benefit to the company's operations.

"The new hot and cold rolled strip mills at the Midland, Pa., works, completion of which is expected in the near future, will provide Crucible with a full line of special stainless, alloy and high-carbon steel strip products having innumerable manufacturing and fabricating applications."

NEW ENGINEERING FIRM FORMED IN PITTSBURGH

▲ Formation of a new engineering firm, Christopher Williams & Co., Inc., with offices at 923 Penn Ave., Pittsburgh, has just been announced.

The new company will act as engineers designing and building rolling mill equipment. Special emphasis will be placed on engineering problems not ordinarily included in the range of activities of larger engineering firms. The company will handle special conveyor and material handling equipment and also act as manufacturers representatives.

President of the new firm, Christopher Williams, was formerly associated with the Mesta Machine Co. and Mechanical Handling Systems.

NEW ADDRESS FOR ENGINEERING FIRM

▲ Auburn & Associates, Inc., electrical engineers specializing in electrical layouts for steel mills and foundation drawings for heavy industry, have announced the removal of their offices to 923 Penn Ave., Pittsburgh, Pa. The general offices of the firm were formerly located in the Grogan Building.

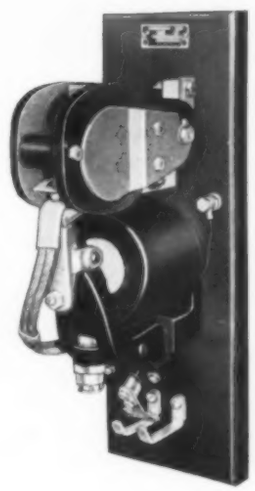
COKE CAPACITY IS INCREASED AT CLAIRTON

▲ Coke production capacity, to supply U. S. Steel blast furnaces in the Pittsburgh district, reached a new high recently when the first coke was

. . . and here's the

CLARK VARI-TIME CORE

which provides the built-in property of delaying for a definite adjustable time, the closing of the contacts in standard D.C. contactors.



Clark Bulletin 7400
Vari-Time Contactor

This timing element or core needs no maintenance nor repairs.

For over 20 years the VARI-TIME principle has been the heart of CLARK D.C. CONTROL, in thousands of heavy duty applications. These installations have been so successfully "trouble-free", that the following guarantee is effective: "THE CLARK CONTROLLER COMPANY will replace *free of charge* any VARI-TIME CORE which will fail in service during the life of the controller."

CLARK VARI-TIME CONTACTORS eliminate all accelerating relays, resulting in wiring simplicity and a minimum of maintenance.

Complete explanation of the VARI-TIME principle and operation is found in Bulletin 7400.

Copies are yours for the asking

ENGINEERED ELECTRICAL CONTROL

THE CLARK CONTROLLER CO.

1146 EAST 152ND STREET, CLEVELAND 10, OHIO

Oxygen cuts electric furnace decarburization time . . . saves power

J. B. BEAIRD COMPANY, Shreveport, Louisiana, wanted to reduce the normal decarburization time of its electric furnace — without affecting the quality of the finished steel.

George Bellew, Airco Technical Sales Representative, was called in to determine what effect the introduction of oxygen in the molten bath would have on refining time. In each of the three trial "heats" oxygen was run just below the slag metal interface.

Several of the advantages of using oxygen in these "heats" were: greater alloy recovery . . . reduced time and power consumption . . . electrode cost per ton lowered . . . elimination of ore handling and storage . . . increased melting rate . . . increased bath temperatures . . . faster carbon elimination.

To date the J. B. Beaird Company has conducted tests on 200 more "heats" — and is highly pleased with the results.

The use of oxygen for decarburization has now become standard practice.

• • • •

TECHNICAL SALES — ANOTHER AIRCO PLUS-VALUE FOR CUSTOMERS

To assure its customers of high efficiency in all applications of the Oxy-acetylene flame or electric arc, Air Reduction has available the broad, practical experience of its nationwide Technical Sales Division personnel. The collective experience and knowledge of these specialists has helped thousands to a more effective use of Airco processes and products. Ask about this Airco "Plus-Value" service today. Write your nearest Airco office. (In Texas: Magnolia Airco Gas Products Company . . . On West Coast: Air Reduction Pacific Company).

AIRCO **AIR REDUCTION**

Offices in Principal Cities

Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Cutting Machines . . . Gas Welding Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

pushed from a completely rebuilt battery of 61 by-product ovens at the world's largest coke plant, operated at Clairton works by Carnegie-Illinois Steel Corp.

With the rebuilt battery, there are now 1567 ovens at Clairton, highest number ever, general superintendent H. W. Seyler announced. Its completion is the latest step in U. S. Steel's $900 million modernization and expansion program throughout the country. More than a year was required to complete the work.

The new battery of ovens is expected to produce close to 325,000 tons of blast furnace coke a year. They replace a battery that was in continuous operation since 1924. The ovens have hydraulic controlled operating equipment and self-sealing doors.

Next move in the company's modernization program at Clairton came May 1 when demolition work started on another old battery that will be replaced with new ovens.

GREAT LAKES ADDS ADDITIONAL COKE OVENS

▲ Great Lakes Steel Corp. at Ecorse, Detroit, Mich., is adding eight ovens each to Batteries Nos. 1 and 2 of the Semet-Solvay vertical flue ovens built in 1938. The extended batteries will then have 73 ovens each. The contract for the sixteen additional ovens has been placed with the Wilputte Coke Oven division of Allied Chemical & Dye Corp.

WAUKEGAN WIRE PLANT TO OPEN JUNE 23

▲ A modern, new stainless steel wire mill at American Steel & Wire Co.'s Waukegan, Ill., works will be opened officially during ceremonies June 23.

The new mill employs specially designed machinery and with a capacity of 500 tons a month makes Waukegan a world center for the production of stainless steel wire, a comparative newcomer to the wire industry.

For many months plant engineers and metallurgists have been developing new techniques for drawing the lustrous, corrosion-resistant wire on a mass-production scale. They expect the mill "shakedown" period to be over in time for the official opening.

Actual construction on the new plant began in July, 1946, and was completed in July, 1948.

RUST BUILDING FURNACE FOR SOUTH AFRICA

▲ Rust Furnace Co. has completed design of a billet heating furnace for South African Iron & Steel Industrial Corp., Ltd., at Pretoria, South Africa, and is currently shipping materials for installation, the company reports. The furnace, a Rust double-zone fired heater, will have a capacity of 50 tons per hour. It will serve a new rod mill of the South African concern.

A contract to design and furnish a fuel oil system and burners for the structural plate mill furnaces of the Brazilian National Steel Co. at Volta Redonda, Brazil, has also been awarded to Rust. The fuel oil system will equip the Brazilian mill furnaces, originally designed by Rust for coke and blast furnace gas, with an additional fuel source. Three furnaces will be served, the contractor reports.

NEW BLISS PRESIDENT INSPECTS 800-TON PRESS

Tackling production problems first hand is Louis C. Edgar, Jr., recently elected president of E. W. Bliss Company. Here Mr. Edgar looks over assembly of a new 800-ton, 4-point Bliss enclosed press being built at the company's Toledo works for a large equipment manufacturer. A production man at heart, the new president once transformed an abandoned tin mill into an efficient, 3000-employee war emergency operation. At that time he was general manager of Blaw-Knox's Martins Ferry division which turned out over $100 million worth of war material.

BOTTLE CAPS USE 4% OF TIN PLATE

▲ The production of beverage bottle caps during 1948 required 163,058 tons of tin plate, though their average individual weight is 0.109 ounces, American Iron and Steel Institute said recently. According to a Department of Commerce report, 48.7 billion of these bottle caps were made last year in 21 plants in the United States. They consumed about four per cent of the total tin plate shipped from steel mills in 1948.

The first step in the manufacture of bottle caps often consists of lithographing the required design on sheets of tin plate. The sheets may then be sheared square, cut into strips and fed into an automatic press which punches out the caps in the desired size and depth.

The metal cap is an American invention which originated in Muncie, Ind., about 1848.

Add years to the Life of your industrial water supply and disposal systems . . .

with this *New* service of

Pittsburgh Pipe Cleaner Company

Pittsburgh Pipe Cleaner Company engineers are trained and equipped to supply corrosion resistant coatings to the pipe lines of your plant.

Corrosive action of acids, salts, pickling, or plating can now be successfully controlled through expert application of one of the following plastic coatings —

GACO-NEOPRENE
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GACO- "316"

WRITE TODAY for recommended solutions of your corrosion problems

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BALTIMORE • BIRMINGHAM • BOSTON • BRADENTON, FLORIDA • BUFFALO • CHARLOTTE
CHICAGO • CINCINNATI • DETROIT • HOUSTON • NEW YORK • PHILADELPHIA • ST. LOUIS

Personnel News...

James M. Stapleton has been appointed division superintendent of blast furnaces for the South Chicago plant of Carnegie-Illinois Steel Corp. He succeeds **George E. Steudel,** retired, and he is succeeded as assistant blast furnaces division superintendent by **W. D. Millar.**

Clarence B. Randall has been elected president of Inland Steel Co., Indiana Harbor, Ind. Mr. Randall had been assistant to the president since October, 1948. Previously he had been vice president of raw materials since 1930. He joined the company as assistant vice president in August, 1925, and has been a director since 1935.

Wilfred Sykes, retired as president of Inland Steel Co., Indiana Harbor, Ind., on April 27. Mr. Sykes' retirement was in accordance with the company's retirement plan.

A. D. Brodie has been appointed superintendent, plate and strip mill, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada. Mr. Brodie was formerly superintendent of the cold strip mill, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

David A. Stuart retired April 30 after 24 years of active service in the sales department of Heppenstall Co., Pittsburgh, Pa. His first employment was in 1901 as a machinist's apprentice at the Pressed Steel Car Co., Pittsburgh. From 1902 to 1905, Mr. Stuart was on the production line of the Pittsburgh Valve Foundry and Construction Co. He had purchasing responsibilities in the Pittsburgh plant of Riter-Conley Mfg. Co. from 1905 to 1910. For the next 15 years Mr. Stuart was the Pittsburgh district sales manager for the Sizer Forge Co., Buffalo, N. Y. He joined the Heppenstall sales department on February 1, 1925.

Kenneth J. Holme was promoted from assistant superintendent of rolling mills to superintendent of the tin mill hot strip mill at Youngstown Sheet and Tube Co., Indiana Harbor, Ind.

Ernest Holme was named assistant superintendent of rolling mills at Youngstown Sheet and Tube Co., Indiana Harbor, Ind. Mr. Holme was formerly roller in the bar and billet mill.

Frank H. Fanning was named vice president, operations for Armco Steel Corp., Middletown, Ohio. Mr. Fanning was assistant vice president.

Arthur B. Cooper was named assistant to vice president in charge of operations, Jessop Steel Co., Washington, Pa. Mr. Cooper was formerly assistant general superintendent. **Edwin C. Thomas, Jr.** became general superintendent, he was formerly superintendent of the bar mill. **Benjamin H. Brown** is now superintendent of electric furnace department. He formerly held the same position prior to April 1, 1948, and has been engaged in consulting work during the past year. **Joseph W. Stier** was appointed superintendent of scheduling. He was formerly employed by the Crucible Steel Co. of America.

F. M. Rich, vice president in charge of operations for Kaiser Co., Inc., now located at Fontana, Calif., will be transferred to the Oakland, Calif., home office of Kaiser Steel in the very near future. Mr. Rich will continue to be responsible for all manufacturing and mining operations of the company. **George B. McMeans,** general superintendent, will be in charge at Fontana.

Carl G. Malmberg, superintendent of Allis-Chalmers Manufacturing Co.'s tank and plate shop, is now also superintendent of the company's forge shop, in Milwaukee, Wis., succeeding **F. A. Breig,** retired. Mr. Malmberg has been employed by Allis-Chalmers since his graduation in 1929 from the University of Illinois.

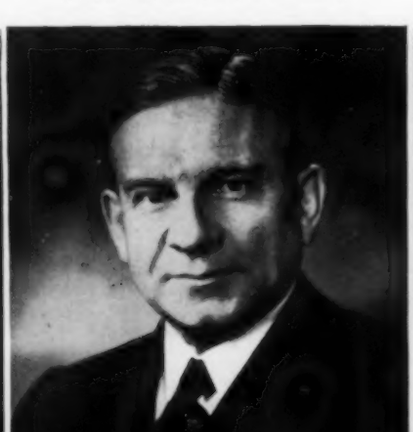
C. A. Tate, district superintendent of the Olive Hill, Ky., and Portsmouth, Ohio works of Harbison-Walker Refractories Co., has joined the Pittsburgh office as assistant divisional superintendent. He will be succeeded by **S. A. Cattlett,** formerly superintendent of the Birmingham works.

Frank A. Weiss was named assistant to general manager, Hyatt Bearings division of General Motors Corp.

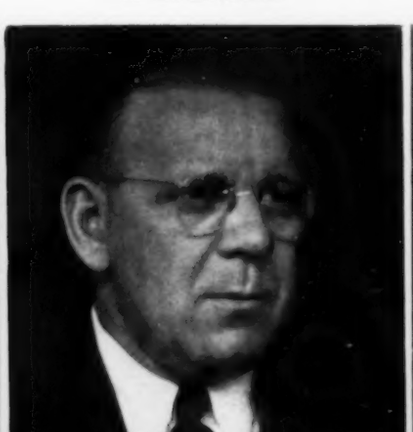
J. H. Tredinnick was named vice president of E. W. Bliss Co. Mr. Tredinnick has been manager of Bliss' Hastings, Michigan plant, which specializes in the manufacture of small and medium-sized punch presses and high production presses.

AMES M. STAPLETON

CLARENCE B. RANDALL



A. D. BRODIE



DAVID A. STUART

J. Barry McCabe, formerly connected with the Pennsylvania Transformer Co., Pittsburgh, Pa., has joined the staff of Bra Bon Electric Co., Philadelphia, Pa. Bra

J. BARRY McCABE

Bon Electric represents the Pennsylvania Transformer Co., the Electric Power Equipment Corp., W. N. Matthews Corp., Roller-Smith Co., and Kellems Co. as sales engineers.

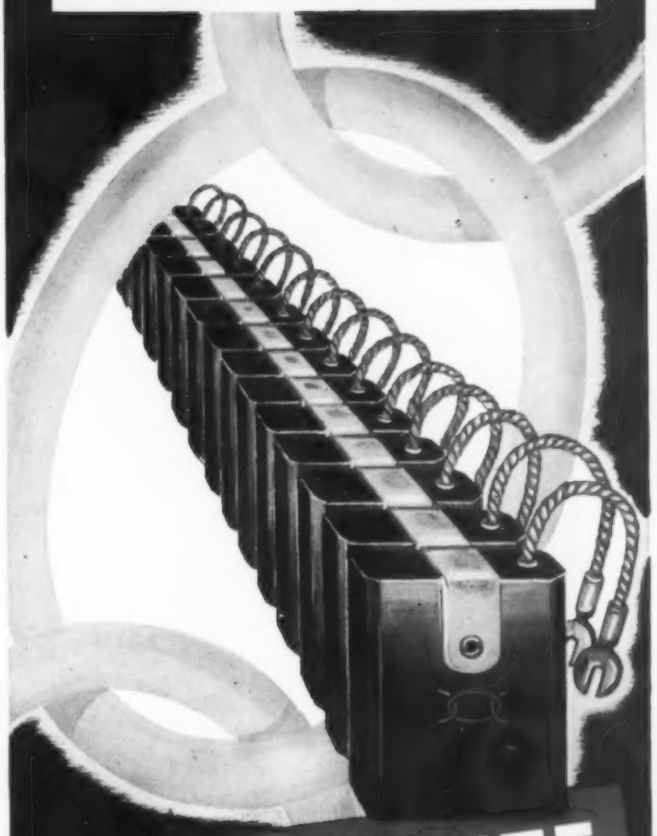
Wallace W. Smith, formerly general superintendent of the Pittsburgh, Pa., plant of Pittsburgh Screw and Bolt Corp., has been appointed manager of operations of both its Pittsburgh and Graham plants. **Russell T. Pollock,** formerly assistant superintendent of the Pittsburgh plant, has been appointed general superintendent of the Pittsburgh plant. **R. L. Irvin,** works manager of the Graham Bolt and Nut division, will continue in his present capacity. **F. B. Gordon,** formerly vice president in charge of operations, and **G. H. Lee** will continue as vice presidents in advisory positions.

R. J. Wean, Jr. was reelected president and treasurer of Wean Equipment Corp., Cleveland, Ohio. Other officers reelected are: **J. R. Paisley,** vice president, general manager and assistant treasurer; **G. J. Ridgeway,** secretary; and **L. R. Connor,** assistant secretary. The following directors were reelected: S. R. Wean, R. J. Wean, R. J. Wean, Jr., H. W. Lynn, D. A. McArthur, and J. R. Paisley.

Philip Finale has joined Loewy Construction Co., Inc., rolling mill division of Hydropress, Inc., as chief engineer. Mr. Finale was associated with the Mesta Machine Co. since 1928, where he held the positions of rolling mill designer and proposal engineer until 1939. At the outbreak of World War II, Mr. Finale assisted the company in the development of a special plant for the U. S. Army. Upon completion of this project, he became rolling mill department engineer, which post he held until he joined Loewy.

James F. McCartney was appointed eastern district sales manager for Duff-Norton Manufacturing Co. with headquarters in New York City. He succeeds **G. L. Mayer** who has retired but who will continue with the company in an advisory capacity. Mr. McCartney was formerly associated with the Pressed Steel Car Co., Inc., and for the past seven years had been eastern representative with offices in New York.

Link YOUR COMMUTATION TO THE RIGHT MORGANITE brush grade



MORGANITE CARBON BRUSHES

The wide range of MORGANITE brush compositions is an important aid when selecting a brush to meet a specific motor or generator operating condition. Equally helpful is the wide experience of MORGANITE engineers who will gladly assist in determining your proper brush grade.

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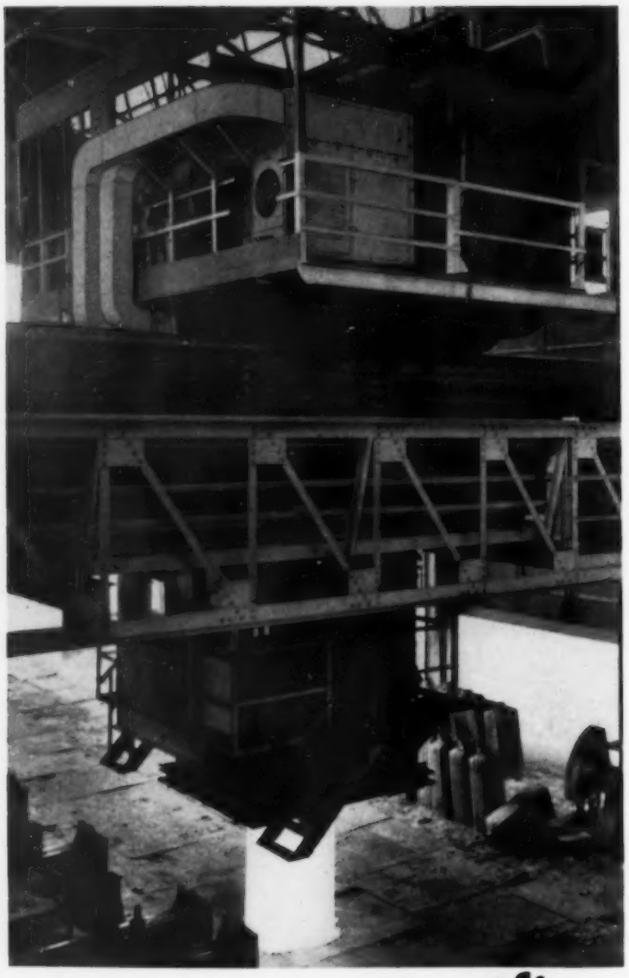
LONG ISLAND CITY 1, NEW YORK

Manufacturers of Morganite Self-Lubricating Carbon Specialties including Seals, Rings, Valves, Slides, Bearings, etc., and Carbon Piles



Lintern Aire-Rectifier
for Soaking Pit Crane Cab

This soaking pit crane in the plant of a prominent steel company, near Baltimore, is equipped with a Lintern Aire-Rectifier with air-cooled condenser. This installation, typical of many others, went through 1947 and 1948 with excellent results. This type of Aire-Rectifier,with air ducts, is suitable for many locations. It has been followed by several installations in this area, including the later models, such as AC-49-27, in which costly air ducts have been eliminated with savings up to 30 per cent.

Whatever your requirements are, whatever your installation problems may be, we have a model exactly suited to the job at the lowest *total* cost to you.

THE LINTERN CORPORATION
54 LINCOLN AVENUE • BEREA, OHIO

Richard W. Berg has been appointed district manager of the Pittsburgh office of Torrington Co., Tor-

RICHARD W. BERG

rington, Conn., and South Bend, Ind. Mr. Berg joined Torrington in 1944 and has been district engineer in the Pittsburgh territory since 1945.

George B. Beitzel was elected president of Pennsylvania Salt Manufacturing Co., Philadelphia, Pa., on the eve of its 100th anniversary year. The new chief executive joined the company 19 years ago and since January 1, 1949, has served as executive vice president. **Leonard T. Beale,** president for the last 20 years, will continue with the company as chairman of the board. **William P. Drake** was elected vice president in charge of sales, and **William F. Mitchell,** vice president in charge of manufacturing.

F. W. Bremmer, for 25 years with National Supply Co., has been elected vice president in charge of manufacturing. The position has been vacant since the retirement of **Charles R. Barton** a year ago. Mr. Bremmer has been works manager of the Spang-Chalfant division's Ambridge, Pa., plant since May, 1948.

E. Lowe McIntyre, Jr. was appointed as assistant sales manager in charge of new market developments

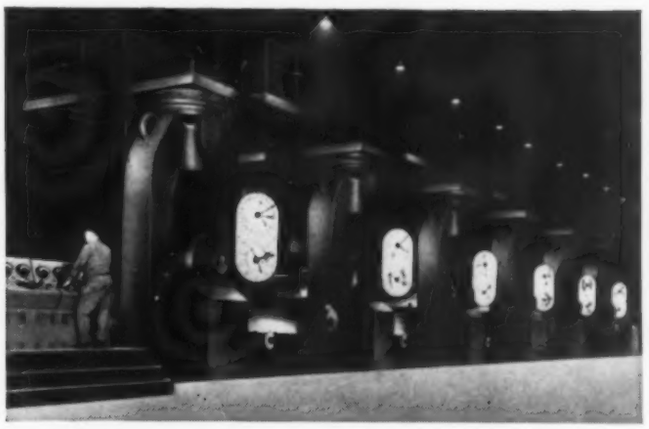
E. LOWE McINTYRE, JR.

for Electric Products Co., Cleveland, Ohio. Mr. McIntyre will be located at headquarters in Cleveland.

Torrington Roll Neck Bearings perform reliably all along the line in Carnegie-Illinois hot strip mill

In the No. 2 rougher of the Gary Sheet and Tin Mill, Torrington Roll Neck Bearings assure reliable performance under tremendous radial and thrust loads.

The No. 4 roughing stands also benefit from the high capacity and smooth operation of Torrington Tapered Roller Bearings.

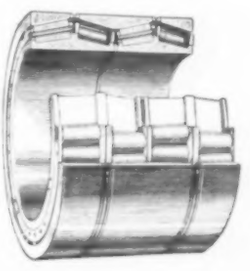


The finishing touch is put on the strip in these stands, with work rolls operating at high speed on Torrington Bearings.

At the Gary Sheet and Tin Mill of Carnegie-Illinois Steel Corp., Torrington Roll Neck Bearings bring many operating advantages in the 80" hot strip mill.

For reliability, they provide tremendous capacity with a reduced cross-section that allows larger roll necks. High productive efficiency, too, results from the smooth operation and rapid acceleration possible with Torrington Bearings. And maintenance is minimized by their efficient lubrication and long service life.

Equip your rolling mills for reliable, economical performance with Torrington 4-row Tapered Roller Bearings. Our engineers are always glad to help with design and application problems. Write us today. THE TORRINGTON COMPANY, South Bend 21, Ind., or Torrington, Conn. District offices and distributors in principal cities of United States and Canada.



TORRINGTON *TAPERED ROLLER* **BEARINGS**

Spherical Roller • Tapered Roller • Straight Roller Needle • Ball • Needle Rollers

HIGH TORQUES?

DE LAVAL SPEED REDUCERS

For low final speeds Worm Gear Speed Reducers should be selected on the basis of output torque ratings.

If your problem is to select a gear reducer capable of carrying high torques, consult De Laval, either directly or through a sales representative.

ONE OF 93

This double reduction De Laval Worm Gear Speed Reducer is available with many standard gear ratios and is but one of 93 sizes and types of standard De Laval Worm Gear Speed Reducers.

Worm Gear Division

DE LAVAL WG-11

De Laval Steam Turbine Co., Trenton 2, N. J.

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS
CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

W. C. McConnell was appointed special representative of the steel industry for Chas. Taylor Sons Co., Cincinnati, Ohio, and Taylor, Ky. In his new position Mr. McConnell will specialize in the application of refractories for steel plants. Widely known in steel circles,

W. C. McCONNELL

Mr. McConnell has had broad experience in the industry, having served as plant superintendent at Republic Steel Corp., Massillon, Ohio, from 1919 to 1942, as assistant works manager at Ridgewood Steel Co., Cincinnati, Ohio, from 1942 to 1946 and as assistant works manager at Mitchell Steel Co. from 1946 to 1948.

Hugh J. Pugsley was elected vice president in charge of the combustion furnace division of Swindell-Dressler Corp., Pittsburgh, Pa. Mr. Pugsley's service with the company extends over 22 years, during which he has been engaged in engineering and sales activities connected with Swindell-Dressler's combustion furnaces for annealing, heat treating and other industrial applications.

E. A. Bertram was named as manager of sales for the Brown Fintube Co., Elyria, Ohio.

E. A. BERTRAM

Ralph O. Wirtenburg has been named sales manager for Norma-Hoffmann Bearings Corp., Stamford, Conn., succeeding **F. W. Messinger,** vice president and sales manager, who has resigned.

WHEN THE ANSWER TO THESE PROBLEMS WILL ADD PROFIT TO YOUR OPERATIONS——

- REDUCE FUEL CONSUMPTION
- STOP BURNING STEEL
- STOP WASHING INGOTS
- INCREASE REFRACTORY LIFE
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- INCREASE YIELDS
- ELIMINATE RECUPERATORS & GENERATORS
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Fort Pitt Bridge Works Subsidiary
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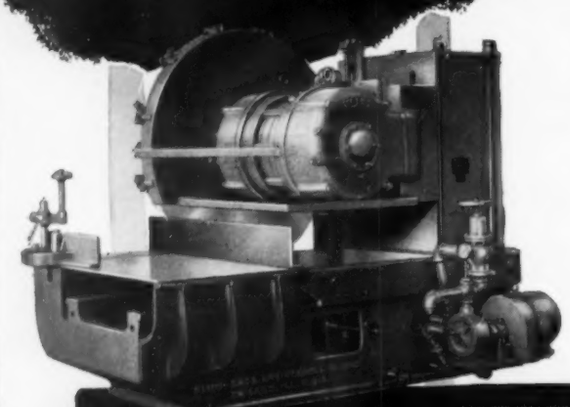
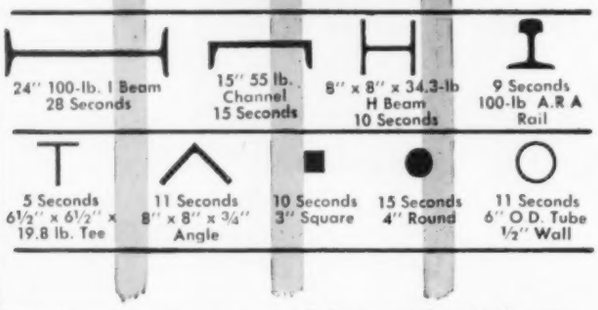
Modern Sawing



with KLING HIGH SPEED FRICTION SAWS



Friction sawing is one of few mechanical processes which employ the heat of friction in a useful manner. It concentrates heat on the material to be severed at a rate which is faster than it can absorb heat. The immediate temperature rise of the contact surface is so great that its strength is reduced considerably lower than that of the colder blade rim. This heated surface is readily removed by the blade and permits complete severing of the material rapidly with no loss of metal from the blade.

Because of its versatile ability to cut many varied structural shapes, as well as solid or hollow bars in any sequence, without change of blade or set-up, one machine can handle a volume of cutting that would otherwise require several separate shears or slow speed saws.

Consult Kling engineers regarding your metal cutting problems. State size of material to be cut. Bulletin No. 9200 giving full particulars and suggestions as to the type and size of saw will be mailed promptly. No obligation.

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Robert C. Wilson has been appointed manager of sales at the Norwood, Ohio, works of the Trumbull Electric Mfg. Co., of Painville, Conn. He joined the sales division of the Trumbull Electric Mfg. Co. in February, 1948.

Eric G. Skarin was named service metallurgist for Ohio Ferro-Alloys Corp., Canton, Ohio. Formerly metallurgist at the Midvale Co., Philadelphia, Pa., Mr. Skarin has had wide experience in steel melting and processing.

L. F. Reinartz and **R. S. Gruver** were named assistant vice presidents of Armco Steel Corp., Middletown, Ohio, and **C. G. Davies,** was appointed administrative assistant, operations division. **J. M. Lobaugh** was appointed manager of the Ashland, Ky., division, succeeding Mr. Gruver. **Harry B. Nicholson** has been made general superintendent of the Ashland plant succeeding Mr. Lobaugh. **George H. Todd** was named assistant general superintendent at Ashland.

Irvin W. Gray has been named assistant electrical superintendent, 98 in. strip mill, Republic Steel Corp., Cleveland, Ohio. **Benjamin T. Beasley, Jr.** has been named assistant electrical superintendent for the steel plant other than the 98 in. mill.

Ernest G. Unrath, former general superintendent of the Ambridge, Pa., plant of the Spang-Chalfant division of National Supply Co., has been promoted to the position of works manager. **S. H. Kilmer,** former superintendent of inspection at the Ambridge plant was appointed general superintendent to succeed Mr. Unrath.

Dr. H. B. Walker has been named manager of the new product development department which was recently established at E. F. Houghton & Co., Philadelphia, Pa.

Edward C. Ford was named assistant secretary of the Jones & Laughlin Steel Corp., Pittsburgh, Pa. Mr. Ford has been an attorney in the J & L legal department since February, 1948, and will continue in that capacity in addition to his duties as assistant secretary.

C. L. Lindholm has been appointed assistant superintendent of the roll department at Harbor works, East Chicago, Ind., of Youngstown Sheet and Tube Co. Joining Gary works of Carnegie-Illinois Steel Corp., Mr. Lindholm worked in the merchant mill, became a roll turner apprentice in 1936, later was roll turner, template maker, draftsman and assistant to the superintendent, the post he held before he left Carnegie-Illinois to take his present position.

Carl B. Pollock, manager of production, was elected vice president in charge of production for Allegheny Ludlum Steel Corp., Pittsburgh, Pa. Mr. Pollock has been associated with the steel industry since his graduation from Washington and Jefferson in 1916. He joined Allegheny Ludlum in 1932 as a department superintendent at the company's Brackenridge, Pa., plant, and by 1944, had worked up to plant manager. He was named production manager in 1946. Mr. Pollock succeeds M. C. Harris who resigned March 4, 1949.

Emil Kern, chief engineer, has been elected vice president of Allegheny Ludlum Steel Corp., Pittsburgh, Pa. Mr. Kern, who was graduated from the University of Stuttgart, Germany, in 1926, began his career as a machinist and designer with Mesta Machine Co. in

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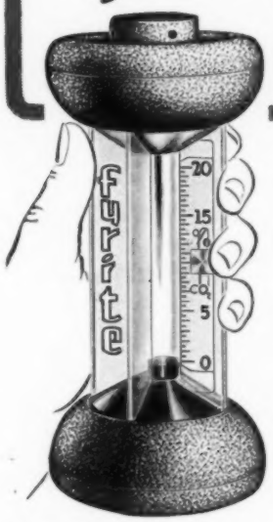

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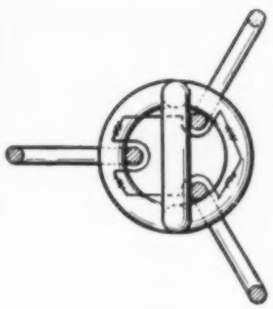

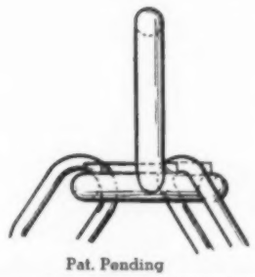

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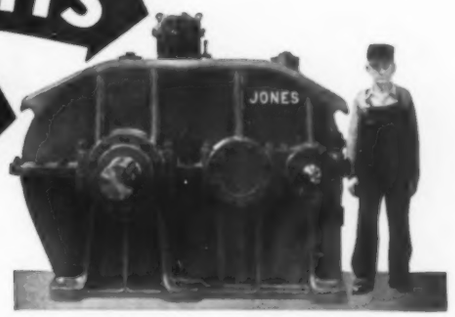

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1930. He became associated with Reynolds Metal Co. as chief mechanical engineer in 1945 and joined Allegheny Ludlum as chief engineer the following year.

Obituaries

Arthur Purnell, aged 60, district sales manager in charge of the Chicago, Ill., sales office of Youngstown Sheet and Tube Co. for 20 years, died suddenly at his home in Evanston, Ill., on April 1. Mr. Purnell was born in Youngstown, Ohio, March 13, 1889 and joined Youngstown Sheet and Tube Co. in 1905.

Frank H. Stohr, 47, general manager of the Allis-Chalmers Manufacturing Co.'s Norwood, Ohio, works, died March 29.

R. Clyde Butler, vice president in charge of operations at Empire Steel Co., Mansfield, Ohio, died March 28, 1949.

Frank E. Vigor, 62, vice president in charge of operations, Armco Steel Corp., died April 12, at Cleveland, Ohio. Mr. Vigor joined Armco in 1910 as a traffic clerk in Middletown. He advanced rapidly; assistant traffic manager, assistant manager and then manager of the company's Ashland, Ky., division. He became general traffic manager for the company in 1939. In 1943 he was elected vice president in charge of manufacturing and mining operations.

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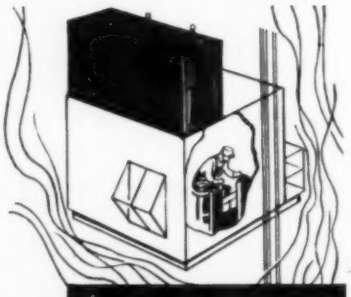

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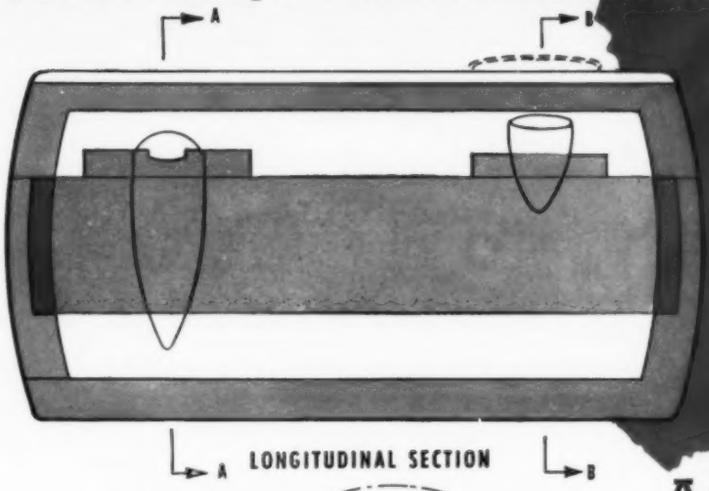
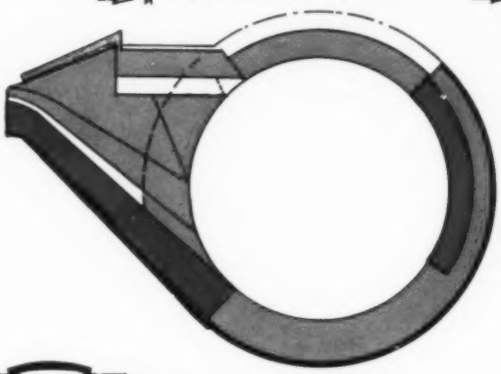




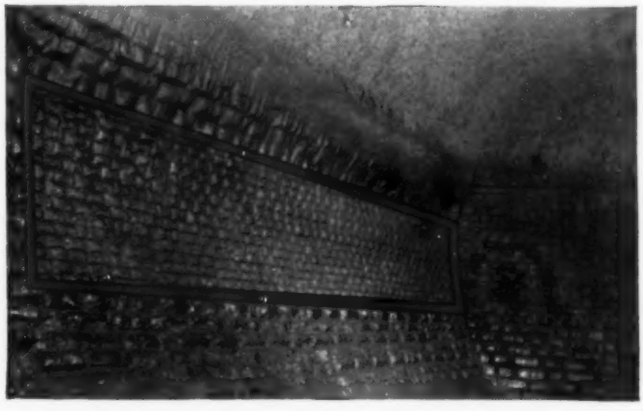
BALANCED
REFRACTORY LINING
1000 TON
HOT METAL MIXER

= Taylor Sillimanite

A large steel mill estimates that they lose a potential of 336 tons of steel every 24 hours when their 1000 ton hot metal mixer is down for repairs. In this mill, the average tonnage through seven mixers, lined with blast furnace quality fire brick, was 330,000 tons between shut downs for relining. In the 1946-47 campaign, the vulnerable areas in the pour-out spout and the front and back walls, at the metal line, were *balanced* with 13½" series TASIL brick laid with TASIL cement. This mixer ran *11½ months* and set a new record of 961,946 tons.

In the 1947-48 campaign, TASIL brick and cement were used in the jambs and bottom of the pour-out spout and for a band across the front and back walls and across both end walls. This *balanced* lining ran *13½ months* and pushed the record to *1,185,000 tons of iron through the mixer!* Substantial savings were recorded in refractory cost, *plus* a material saving in down time and masonry hours. Production was increased by keeping the mixer on the line, with hot metal available when it was needed at the open-hearth.

This is a typical and not unusual case record. Are *you* getting equal results? Hot metal mixer and hot metal car linings, *balanced* with TASIL refractories, are in service now at other mills. Call in the Taylor field engineer in your district for a factual discussion of this and other steel mill applications for Taylor special refractories.



Taylor Sillimanite in east wall of hot metal mixer *after* 961,946 ton campaign in 11½ months. Note the minimum of joint erosion. In previous campaign, blast quality fire clay brick lining eroded and had to be replaced after seven months.

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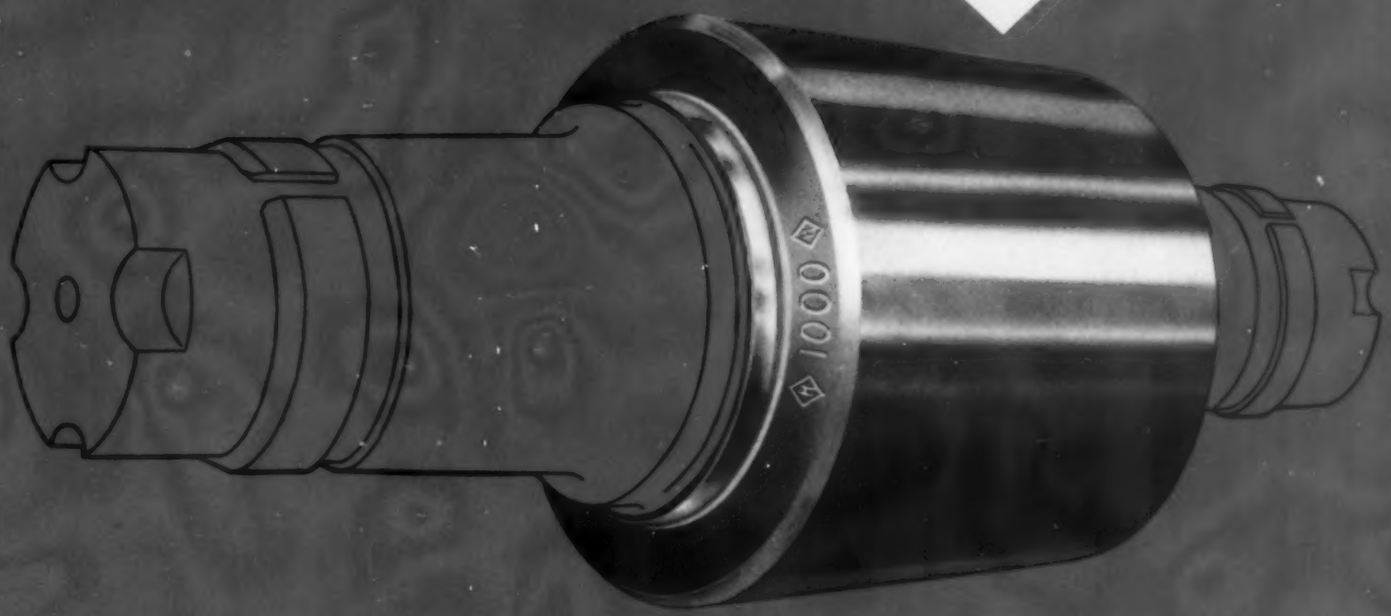

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   - (c) Pressure and temperature compensated flow meters
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   - (b) Gas-air ratio
   - (c) Stove dome temperature

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1. AIR FLOW OR AIR PRESSURE CONTROL
   - (a) Flow meters

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3. FUEL-AIR RATIO CONTROL
4. FURNACE DRAFT REGULATION
5. AUTOMATIC FUEL MAKE-UP CONTROL
6. STEAM AND WATER DISTRIBUTION METERING AND CONTROL

COKE OVENS

1. EXHAUSTER CONTROLS
2. COLLECTING MAIN PRESSURE REGULATORS
3. STACK DRAFT CONTROL
4. UNDERFIRING GAS PRESSURE REGULATORS
5. MILLIMETER GAGES
6. FLOW RECORDERS

OPEN HEARTH AND HEATING FURNACES

1. HEAT INPUT CONTROL
2. ROOF TEMPERATURE CONTROL
3. FURNACE PRESSURE CONTROL
4. FUEL-AIR RATIO CONTROL
   - (a) Oil Firing
   - (b) Gas firing
5. REVERSAL CONTROL
6. DRAFT AND PRESSURE RECORDERS
7. FLOW METERS
8. B. t. u. METERS (Mixed fuel Firing)

SOAKING PITS

1. TEMPERATURE CONTROL
2. FUEL-AIR RATIO CONTROL
   - (a) Oil firing
   - (b) Gas firing
3. FURNACE PRESSURE CONTROL
4. GAS PRESSURE CONTROL

HEATING FURNACES

1. HEAT INPUT CONTROL
2. FUEL-AIR RATIO CONTROL
   - (a) Oil-firing
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(1) Control of Stream Pollution

To show how numerous steel mills and other plants are effectively combating stream pollution through the use of standard pH equipment which automatically controls the neutralization of waste, a 20-page bulletin has just been published entitled, "For Effective Neutralization of Industrial Wastes." This new publication describes a unique "controllability analysis" by which engineers are advising management in advance whether waste pH can be kept within prescribed limits. Described and pictured are the two control systems — electric and pneumatic control. (ND44-96-708). Leeds & Northrup Co.

(2) Roll Grinding Machines

A booklet is available on heavy-duty, roll grinding machines. This booklet describes the principal features of several types of roll grinding machines with illustrations and schematic photographs showing the operating controls. Included are the general specifications, the standard equipment supplied with the machine, the electrical equipment and specifications equipment supplied at extra cost and special equipment supplied at extra cost. If you are concerned with the grinding of rolls, we recommend that you have this in your file. (G-587). Cincinnati Grinders, Inc.

(3) Pushbuttons Unlimited

Endless combinations and many new features to take care of almost every need — are described in a folder recently published on a complete line of standard and heavy duty pushbutton stations. For local or remote operations in most general duty applications, the standard one, two and three button stations handle current where service is not extremely severe. To meet exacting requirements, heavy duty stations have been engineered to assure reliable performance under severe operating conditions. Cutler-Hammer, Inc.

(4) Water Treatment

Five bulletins are available to you on the subject of water treatment. The first discusses Dearborn briquettes in cooling systems and in hot water supply systems. The second discusses the rapid removal of scale in diesel engine cooling systems, hot water heating coils, heat exchangers, stage heaters, water meters, evaporators, condensers, feed lines, boilers and pumps. The third is on the subject of the control of corrosion in brine circulating systems and freezing tanks. The fourth bulletin covers the control of return line corrosion. The fifth bulletin is a 20-page booklet on de-ionizing systems for purifying water at low cost. (5001, 5002, 5003, 5004 and 5005). Dearborn Chemical Co.

(5) Dust Collection

A booklet is available on "Thermix Products." This booklet covers fan-stacks, fans, tubular dust collectors, duplex dust collectors, multicones and recirculators for flue gas control. Each one of the foregoing subjects is discussed in detail and the sections on dust collection are very informative. Besides the discussion of these products and what they will do in industry, a section is devoted to specific application of these products. A complete list of the companies using these products is included in this booklet. Another valuable addition to this booklet is a list of many of the technical articles covering dust collection in industry. (200). Prat-Daniel Corp.

(6) "Power Factor . . .

. . . and what to do about it" — new 20-page, pocket size, booklet explains the essentials of power factor in industrial plants and gives a digest of power factor calculation, why low power factor should be corrected and how it can be done. (200 TEC 1077). Electric Machinery Mfg. Co.

(7) Solving Corrosion Problems

A new bulletin, "Solving Corrosion Problems with Chemalloy High-Alloy Castings," has been released. This bulletin features two important charts that will help in selecting the right alloy for most corrosive conditions. A "Quick Selector" shows the comparative corrosion resistance of the most commonly used grades in 179 different corrosive media. The bulletin also includes a list of standard corrosion-resistant alloys showing ACI types, AISI types and Chemalloy grades with their nominal composition, mechanical properties and descriptive remarks about each. (T-171). Electro Alloys division of American Brake Shoe Co.

(8) Nitralloy Steel

A new 8-page engineering data bulletin describes Nitralloy, a special alloy steel suitable for extreme wear and abrasion resistance. Included is table of Nitralloy compositions, hardness curves, mechanical properties, information on nitriding and heat treatment, and typical applications. Joseph T. Ryerson & Son, Inc.

(9) Condensate Drainage Control System

Publication of an expanded 24-page bulletin on high pressure condensate return systems is announced. Data on steam flow conditions and heat exchange characteristics make the technical portions of this new book particularly useful to engineers responsible for the efficient transfer of steam heat in heating, cooking, drying, and pressing operations. To accomplish the return of condensate to higher pressure boilers from presses, dry-

ers, and other steam heated process equipment Cochrane engineers have developed the new high differential condensate return system to supplement the standard unit. In addition to material and operating specifications capacity ratings are given for both standard and high-differential units in the six different sizes available — 3, 5, 7½, 10, 15 and 25 hp — based on a maximum of 200 psi above process pressure. Differential pressures to 200 psi are listed and capacities for each unit are tabulated after each differential pressure for unit inlet pressures varying from 0-39 psi, 40-99 psi and for over 100 psi. (3250). Cochrane Corp.

(10) Industrial Turbines

A new 20-page booklet recently released contains basic information on industrial turbines. Cutaway views show operating features and general construction. Various wheel sizes are enumerated and a guide is given to aid in selection of the proper turbine for steam conditions and type of load. Detailed descriptions of parts of the turbine illustrate features such as the governor assembly, overspeed valve, and general corrosion and erosion resistance. (B-3896). Westinghouse Electric Corp.

(11) Air Motor Power Jack

Industrial lifting and lowering jobs, sinking piling, and locomotive repairing are only a few of the many applications of Duff-Norton air motor power jacks which are illustrated in a colorful eight-page bulletin recently issued. Recognized for their dependability, economy and time-saving features, these air motor power jacks have a maximum capacity of 100-tons, and cut the time on most lifting jobs to only a fraction of that required by manually operated jacks. One man using two of these air power jacks can raise a railroad car in less than five minutes while the same job with manually operated jacks takes four men 38 minutes. A "Y" connection between jacks enables one man to operate two jacks simultaneously. (AD11-249). Duff-Norton Manufacturing Co.

(12) Resistance of Nickel Alloys to Corrosion

A new technical bulletin on the resistance of high nickel alloys to corrosion by sulfuric acid has been issued. While the bulletin is technical in nature, it is written so that it can be readily understood by non-technical as well as technical staffs of industries in which corrosion by this useful but highly corrosive agent is a problem. Performance of over 30 different nickel-bearing materials in a wide range of services is discussed. Prepared by corrosion engineers, the bulletin contains 86 tables and 33 graphs and photographs in addition to text matter. Problems involving the pickling of steel are discussed. (Technical Bulletin T-3). International Nickel Co., Inc.

(13) Industrial Heating Program

Five different application data booklets covering the major uses of tubular, strip and cartridge heaters in industry are available to you. The first of these is entitled, "Heating Pipe Lines with Electric Heaters"; the second is entitled, "Melting Soft Metals with Electric Heaters"; the third is called, "Heating Process Air with Electric Heaters"; the fourth is "Heating Liquids with Electric Heaters"; and the fifth is "Heating Surfaces with Electric Heaters." (1035265, 1052609, 1052625, 1052651, and 1053868). General Electric Co.

(14) Lifetime Industrial Battery

A booklet is available on the new nickel cadmium battery. This booklet discusses the many advantages of this revolutionary battery, including its complete freedom from self-deterioration. This is due to the use of an alkaline electrolyte which does not attack the plates or the active metal contained in the plates. It describes the battery's ability to be trickle-charged or floated at existing voltage settings on charging equipment used for lead batteries. The nickel cadmium battery does not require careful adjusted charging rates as they may be over-charged without damage. Included with this bulletin is an article on the nickel cadmium battery which appeared in POPULAR SCIENCE MONTHLY. Nickel Cadmium Battery Corp.

(15) Solidified Heat

A bulletin is available which all people who use coal should read. It was designed primarily to get coal producers on their toes to produce better fuels and eliminate wasteful cost to the users of coal. The users of coal should also be informed on how to get the most heat per hour out of the coal they are purchasing. (449). George P. Reintjes Co.

(16) Industrial Construction Catalog

A record of the many projects handled by a large construction company is available to general superintendents, chief engineers and construction supervisors. This booklet describes complete plant erection, structural steel erection, the precision installation of all types of machinery, the relocation of industrial units — such as blast furnaces — and the construction of foundations for buildings and equipment. Almost every phase of plant expansion is included in this book. There is included descriptions of fuel lines, temper mills, coil conveyors, flying shear lines, and galvanizing lines. A description of the moving of two blast furnaces is also included. Eichleay Corp.

(17) Rotary Positive Gas Pumps

A bulletin covering rotary positive gas pumps has just been issued. The bulletin describes the advantages of this type compared with the operating characteristics of other type gas pumps. Illustrated are the four standard types now being offered, with line drawings showing a longitudinal section of each type. These units cover a range from 2000 to 50,000 cfm at pressures up to 10 lbs in two types, and up to 15 lb in the other two. The gears, bearings, and stuffing boxes are illustrated and described. Typical installations covering a wide variety of industrial applications are discussed. (32-33-B-13). Roots-Connersville Blower Corp.

(18) Fuel Oil Treatment

Literature is available describing a new fuel oil treatment called "Dacarol A." The literature describes how this new product has more effective atomization and greater Btu release. The product is an activated fuel oil treatment which readily attacks oil sludges

and water contamination. Use of this material has resulted in cleaner tanks and lines, less carbon deposits in preheaters and on burner tips. Overall results show less maintenance and greater efficiency in the operations of related fuel oil burning equipment. Dacar Chemical Products Co.

(19) Ball Bearing Swivel Joints

A complete catalog has just been issued on ball bearing swivel joints for all purposes. It discusses the development of over 500 different types, styles and sizes for pressures from 0 psi to 12,000 psi, for vacuum service, and for temperatures from 225 F to 500 F. It tells how, in the manufacture of these swivel joints, all parts are machined to close tolerances. Wall thicknesses are uniform throughout. (48). Chiksan Co.

(20) Spool Insulator Cable Supports

A catalog is available describing spool insulator cable supports telling how you may save space, reduce installation time and have the advantage of great flexibility. Included in this catalog is a table which will enable you to calculate the proper wire size required. Other tables are given for the various table cable supports. Cutaway drawings show the construction features. (4901). Delta-Star Electric Co.

(21) A-C Generators

Alternating-current, high-speed, coupled-type generators are described in a new eight-page bulletin just released. Construction features of both the bracket and pedestal type bearing synchronous generators are given with the explanation that they provide efficient, reliable power for construction work, permanent or temporary lighting and power jobs, mines, quarries, plants in remote areas, marine installations, and as reserve power for factories, pumping stations, etc. A table of ratings of standard bracket bearing generators is included. Bracket bearing construction is generally used for the smaller sizes for ratings up to one kva per rpm, while pedestal bearing construction is generally used for ratings above one kva per rpm and for all generators above 1,000 kva, according to the bulletin. (Bulletin 05B6031B). Allis-Chalmers Manufacturing Co.

(22) Lubrication Studies

"Studies in Centralized Lubrication for 1949" shows the outstanding economies reported by the users in several industries, including: savings in labor of oiling, savings in lubricant consumption, elimination of down time, and increase of machine production. Savings like these are important when industry is vitally concerned with ways to eliminate unnecessary operating and maintenance expense. The Farval Corp.

(23) Water Hose

A new catalog section on lines of water hose used in a wide variety of services in industry, construction and mining is now available upon request. The section pictures and describes construction of each type water hose the company manufactures, lists recommended uses and gives detailed specifications and coupling information. (4800). The B. F. Goodrich Co.

(24) Acid Diluting Equipment

"Karbate" brand sulphuric acid diluting equipment is described in a new catalog section recently made available. The bulletin describes a complete system for the efficient production of cool dilute sulphuric acid from the required quantities of commercial strength acid and diluting water. It points up the equipment's adaptability to automatic control, and forced convection cooling and counter-current flow in a closed system operation requiring no dilute acid pump. (Catalog section M-8806A). National Carbon Co., Inc.

(25) Standardized Transformer Parts

A new eight page booklet has just been issued which describes Standard Parts Transformers. The bulletin describes transformers which have such latitudes in voltages and accessories that they are actually custom built transformers which can be had at quantity production cost. This has been done through the standardization of the company's power transformer designs and construction methods. These transformers are available from 10,000 kva and below for three phase transformers, 5,000 kva and below for single phase transformers and all in voltages up to 34.5 kv. (1492). Pennsylvania Transformer Co.

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50	AMERICAN FLEXIBLE COUPLING CO.		Booklet, "Relief from Wearing Grief."
		CATALOG 41	Describes American flexible couplings.
51	BACHARACH INDUSTRIAL INSTRUMENT CO.	BULLETIN 740	Describes the Fyrite CO_2 Indicator.
		LEAFLET 700	Describes the oxygen indicator for direct oxygen analysis.
52	BEDFORD FOUNDRY AND MACHINE CO.		Catalog describing cranes of any span or lift.
53	BONNOT CO.		List of plants where you can see the Billeteers saving money for the user.
54	BROWNING AND CO., INC., VICTOR R.	BULLETIN S	"Cranes Built As You Yourself Would Build Them."
55	BUFFALO FORGE CO.	BULLETIN 3650	Describes mill type shears.
56	BUSSMANN MANUFACTURING CO.		Complete facts about Fusetron dual-element fuses.
57	CLARK CONTROLLER CO.	BULLETIN 7400	Describes the "Vari-time" contactor.
58	CUTLER-HAMMER, INC.	PUBLICATION BR-2	Describes Type M Brake designed for heavy duty installation.
59	ELECTRIC CONTROLLER AND MANUFACTURING CO.	BULLETIN 905	Describes automatic-discharge magnet controllers.
60	ELECTRIC SERVICE MANUFACTURING CO.		Detailed information on insulators, rail shoes, and current collectors.
61	FARREL-BIRMINGHAM CO., INC.	BULLETIN 115	Describes Farrel heavy duty roll grinders.
62	FARVAL CORP.	BULLETIN 25	Full description of Farval centralized lubrication.
63	GENERAL ELECTRIC CO.	BULLETIN GEA-4654	Technical data on MD-600 mill motors.
64	HAYS CORP.	BULLETIN 48-750	Covers instruments and controllers for heat treating furnaces. A companion edition on open hearth furnaces will be included.
65	HUNT AND SON, INC., C. B.		Catalog on "Quick-as-Wink" lever operated hydraulic valves.
66	JONES FOUNDRY AND MACHINE CO., W. A.	CATALOG 70	128-page catalog describing herringbone speed reducers
67	KOPPERS CO., INC., FAST'S COUPLINGS DEPT.		Describes Fast's gear-type couplings.
68	KLING BROTHERS ENGINEERING WORKS	BULLETIN 9200	Describes high speed friction saws.
69	LEEDS AND NORTHRUP CO.		Folder on new temperature instrument for testing and plant use.
70	LINCOLN ENGINEERING CO.	CATALOG 63	Describes Lincoln "Centro-Matic" lubricating systems.
71	MARVEL ENGINEERING CO.	CATALOG 103	Describes the synclinal filter which has 2½ times more filtering area than circular type filters.
72	OAKITE PRODUCTS, INC.		"Improved Pickling and Neutralizing with Oakite Materials."
73	OKONITE CO.		52-page self-supporting cable book for electrical engineers and steel plant executives.
74	POOLE FOUNDRY AND MACHINE CO.		Catalog giving full description and engineering data on flexible couplings.
75	POST-GLOVER ELECTRIC CO.	BULLETIN 500	Detailed information on steel grid resistors.
76	READY-POWER CO.		Descriptive literature on generating dependable electric power for electric trucks with an engine-driven, d-c generator.
77	RELIANCE ELECTRIC AND ENGINEERING CO.	BULLETIN 311	Describes packaged all-electric V*S drive.
78	SQUARE D CO.	BULLETIN 600	Describes thermal magnetic circuit breakers.
79	TIDE WATER ASSOCIATED OIL CO.		Informative handbook entitled, "Tide Water Associated Lubricania," which gives descriptions of basic tests of oils and greases.
80	WAGNER ELECTRIC CORP.	BULLETIN MU-185	Full information on the complete line of Wagner motors.
81	WESTINGHOUSE ELECTRIC CORP.	BOOK B-3776	Gives data and application help on the use of Micarta bearings.

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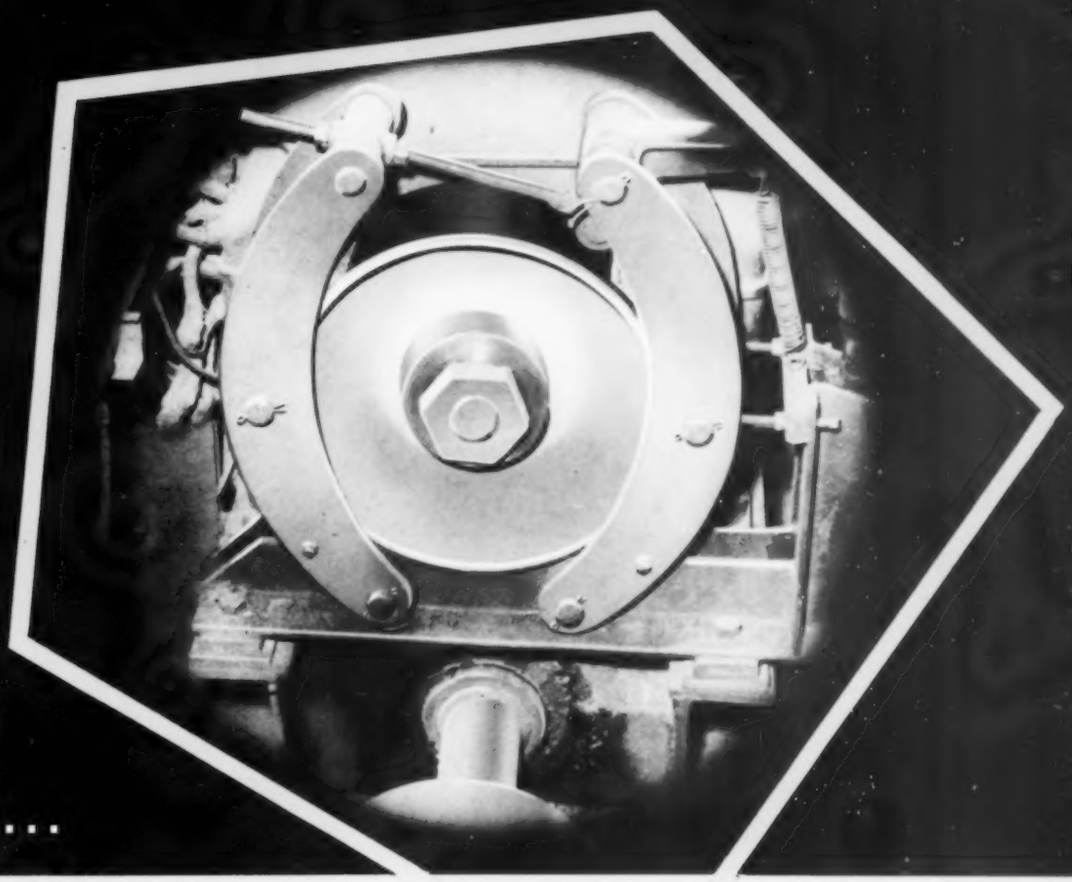


"TOOL STEEL" PROCESS

BRAKE WHEELS . . .

provide

GRANITE CITY STEEL COMPANY

with LONGER LIFE FEWER LINING CHANGES LOWER MAINTENANCE

"Tool Steel" brake wheels outlasted cast iron wheels on this hot strip mill crane drive by **22 times** . . increased brake lining life by **5 times!**

This superior quality which has found such high favor for "Tool Steel" brake wheels is also built into "Tool Steel" gears and pinions, wheels, rolls, and other "Tool Steel" hardened products!

WE GUARANTEE our products to give sufficient life over any other grade of hardened material operating in the same service to cover any difference in first cost. If our material fails to fulfill this guarantee, we will make good the deficiency in either cash or new material.

THIS GUARANTEE WAS ORIGINATED BY AND IS EXCLUSIVE WITH THE TOOL STEEL GEAR AND PINION CO.

HERE'S GRANITE CITY'S COMPARISON:

	"TOOL STEEL" WHEELS	CAST IRON WHEELS
SERVICE LIFE:	22 Months (Continuous) *	1 Month Average
BRAKE LINING LIFE:	45 Days (Average)	9 Days Average

* These "Tool Steel" brake wheels were removed after 22 months, reground and placed in service on another crane!

This service life can be equalled by no other products! Write today for complete information.

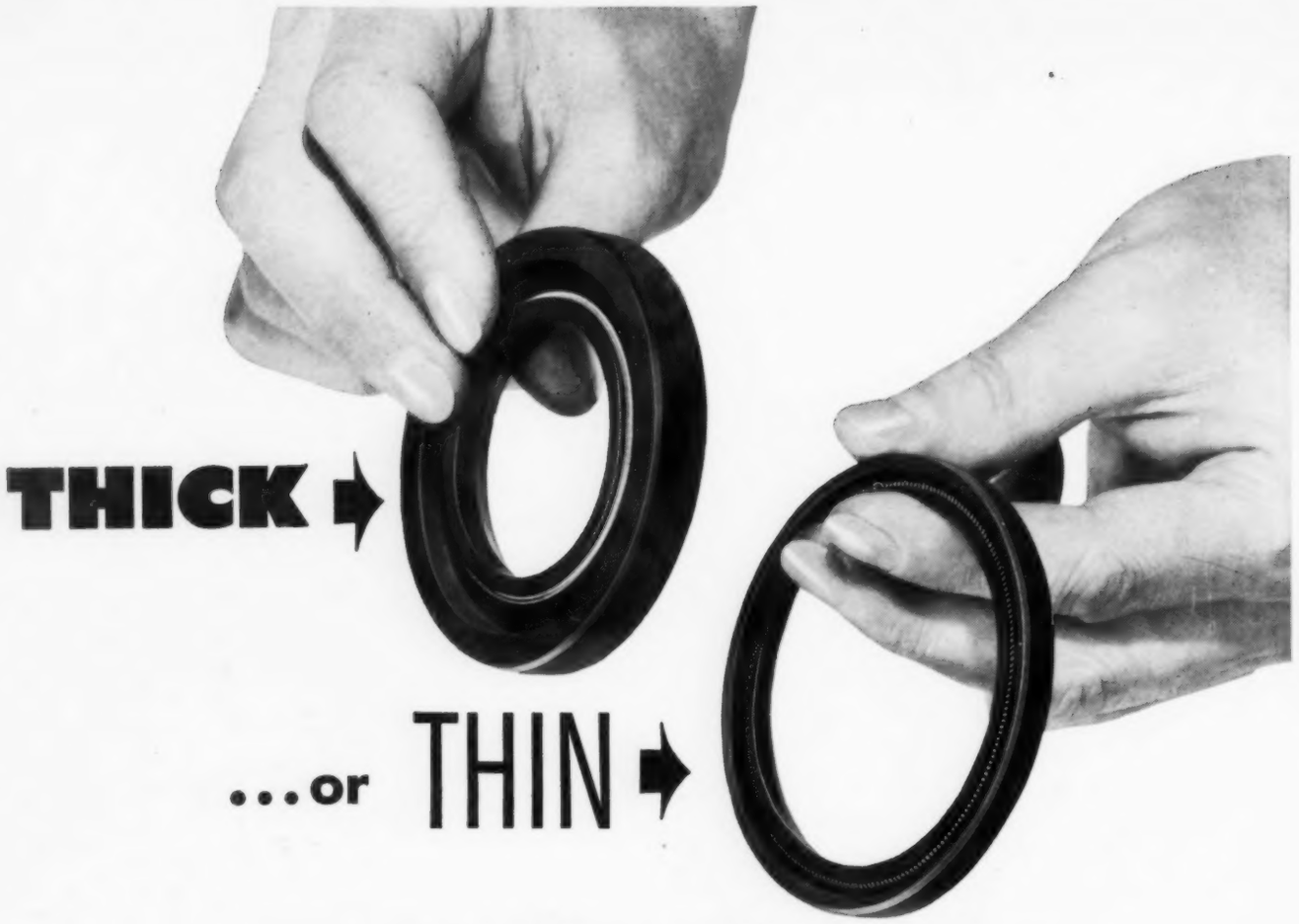
"TOOL STEEL" PROCESS

The Standard of Quality

for GEARS • PINIONS • ROLLS • WHEELS *and other* HARDENED PRODUCTS

THE TOOL STEEL GEAR & PINION CO.

CINCINNATI 16, OHIO, U. S. A.



...an oil seal design for any cavity

CLIPPER SEALS offer unusual design possibilities . . . and unusual design economies, too.

For example, this new Johns-Manville oil seal is available in flange sections of varying width to fit practically any cavity. In fact, because of the adaptability of its unique one-piece design, there is no cavity mechanically practicable which is too shallow—or too deep—for a Clipper Seal.

Furthermore, because the Clipper Seal has no metal case and is of flexible molded construction, this oil seal permits liberal machining tolerances in the design of the cavity. Its tough, dense outer heel is resilient enough to conform to even a slightly out-of-round cavity. Yet this does not interfere with the seating of the pliable inner lip which always maintains a light, but positive sealing pressure on the shaft for minimum wear.

Clipper Seals are entirely non-metallic, which eliminates the possibility of electrolysis; are available in split and endless types, for sealing against oil, grease, water, air, grit and coolants, in sizes from ¼" I. D. to 66" O. D. If you would like to consult us about a design problem, write Johns-Manville, Box 290, New York 16, N. Y.

Recommended Clipper Seal Flange Sections

Shaft Diameter Inches	Increments	Light		Medium		Heavy	
		Flange Width	Heel Depth	Flange Width	Heel Depth	Flange Width	Heel Depth
⅛ thru 1½	1/16"	¼"	5/16"	5/16"	5/16"	⅜"	7/16"
1 9/16 " 2	1/16"	5/16"	5/16"	⅜"	7/16"	½"	7/16"
2⅛ " 2⅞	⅛"	5/16"	5/16"	⅜"	7/16"	½"	7/16"
3 " 5⅞	⅛"	⅜"	7/16"	½"	7/16"	⅝"	⅝"
6 " 9⅞	⅛"	½"	7/16"	⅝"	⅝"	¾"	⅝"
10 " 19¾	¼"	⅝"	⅝"	¾"	⅝"	1"	⅞"
20 " 29¾	¼"	¾"	⅝"	1"	⅞"	1¼"	⅞"
30 " 36	¼"	1"	⅞"	1¼"	⅞"		

Recommended dimensions for shaft diameters from ¼" to ⅛" and over 36" on request.

Johns-Manville **PACKINGS & GASKETS**

LINK-BELT CONVEYORS
Carry a lot of weight,–SAFELY!

Smooth-running, husky Link-Belt Conveyors handle coils of strip steel weighing up to 25,000 pounds each, with complete freedom from damage, in this modern mill in Northern Ohio. Rugged construction with spacious bearing surfaces, prevent the sag and drag that scuff edges. Telescoping is eliminated; scrap losses are greatly reduced. Production is speeded, costs are lowered. The inset above shows details of the type of conveyor used.

In the steel industry where weights and sizes of loads run large, and yet where gentle handling is a must, Link-Belt conveyors offer many advantages. Whatever your materials handling problem, let Link-Belt assist you, through engineering, manufacturing and installation, to obtain efficient, cost-reducing mechanization.

TYPES OF LINK-BELT CONVEYING MACHINERY

Belt Conveyors	Oscillating Conveyors
Screw Conveyors	Apron Conveyors
Bulk-Flo Conveyors	Flight Conveyors
Chain Conveyors	Bucket Elevators
Trolley Conveyors	Bucket Carriers

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 3, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

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LINK-BELT

CONVEYING MACHINERY

"THE COMPLETE LINE"

BUILT BY MORGAN Engineering

MORGAN 600-TON MOTOR DRIVEN STRUCTURAL SHEAR

Illustrated is a Morgan 600-Ton Motor Driven Structural Shear for shearing products from a Morgan 29″ and 23″ Rail and Structural Mill. It will shear up to 4½″ x 4½″ Billets and 4½″ Rounds; Eye Beams and Channels up to 15″; a full line of Angles with equal and unequal legs up to 8″ x 8″; also Fish and Tie Plates.

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO. 1420 Oliver Building, Pittsburgh

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Equipment News...

ROTATING CRANE CARRIER FACILITATES HANDLING OF COILED ROD AND WIRE

▲ The expression "something has been added" frequently heard in the promotion of many consumer products truly applies to a new revolutionary carrier developed by the Cleveland Tramrail division of Cleveland Crane & Engineering Co.

That additional "something" is a rotating travel motion that enables the carrier to do everything but dance a jig.

The carrier and crane on which it operates has just been put into operation in a large warehouse for the handling of coiled rod and wire. The handling problem here was unusual in that it was necessary to not only pick up coils of rod from incoming railroad cars, but to turn them ninety degrees when placing into the large storage bins. Because of this and the fact that rod is handled by a hairpin-type hook which is tilted either up or down when threading into or drawing away from coils, the following travel motions were required: (1) hoisting, (2) tilting, (3) trolley travel, (4) bridge travel, and (5) rotation.

The equipment consists of a crane which travels the length of the storage building, a trolley which travels on the bridge from side to side of the building and a rotating carrier that operates on a circular track built into the trolley. The carrier has two separate hoists, cables from which are reeved to the two ends of the hairpin hook.

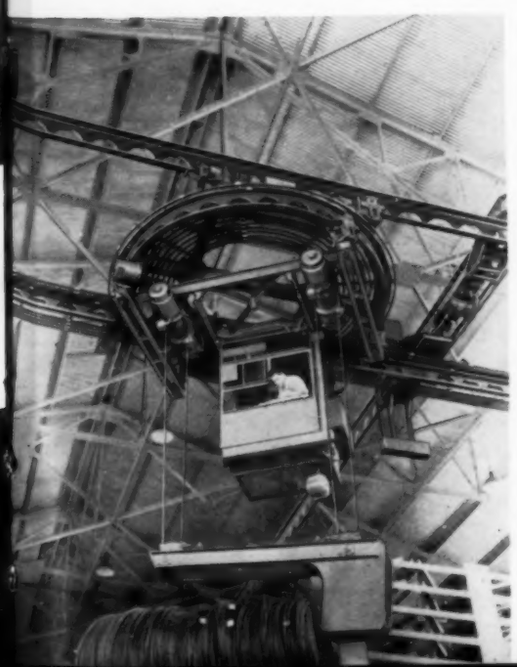
All motions of the equipment are controlled by the operator in the cab attached to the carrier. He can run the unit to any point in the building and turn the carrier clockwise or counterclockwise through short arcs or complete turns, thereby turning the hook to any direction desired. The hook can be raised, lowered, tilted upwards or downwards by separate or simultaneous operation of the hoists. Thus utmost flexibility in the handling of the rod and wire is secured.

Speeds of this equipment are: bridge 400 fpm, trolley 200 fpm, hoist 50 to 80 fpm, and rotation 75 fpm. Bridge and trolley control are variable five-speed magnetic with dynamic braking. Hoist control is variable-speed drum type with dynamic lowering. Rotating control is automatic accelerating.

The cab is open-type with landing platform and has glass and grating in floor. A safety switch in cab can stop all motions in case of emergency. A motor-driven horn and flood light are also provided.

This unit was designed to carry 3500 lb of rod in addition to the weight of the hairpin hook. Similar equipment can be furnished for other capacities and operating speeds. Variations of this equipment can also be designed for other materials handling purposes.

All motions of the equipment are controlled by the operator in the cab.



ALUMINUM SAFETY STAMP WEIGHS 50 PER CENT LESS

▲ The most recent addition to the new "Luminum-Line" series of marking tools made of aluminum by the M. E. Cunningham Co., is the axle end marker for stamping end faces of railroad car axles, forged wheel blocks and other large rounds.

Identified as the "Luminum-Line" axle end marker, this dependable stamping tool is now cast from a tough-grade alloy aluminum which provides the long-service life of previous steel models, but cuts the weight of the unit approximately 50 per cent.

The standard model axle end marker is furnished with any combination of characters and sizes, and is adaptable to almost any marking requirement. However, other setups are available on request. The holder can be adjusted to center on different size diameters, and a rounded rib design around holes protects them from off-angle blows. Characters are quickly inserted and removed by hand, but remain securely in place during stamping. Floating friction springs facilitate the quick removal and insertion of stamps.

With the exception of a wooden handle and steel springs, the new marker is fabricated of aluminum. Because of a special casting method, the new holder costs considerably less than previous models.

RIVER ROUGE USES TONGS FOR COIL HANDLING

▲ To eliminate the necessity of ground crews working close to hot annealing covers, Ford Motor Co. has installed specifically designed automatic tongs for handling cold rolled steel strip and other material handling operations at its River Rouge plant.

The special coil handling and annealing cover tongs used by Ford were designed in cooperation with Heppenstall Co.

According to annealing department supervision, the automatic tongs which require no electricity for holding are particularly advantageous in positioning one 30,000 lb coil upon another. This must be done cleanly and accurately. Rough handling results in damaged coil edges. Bent metal must be trimmed off with subsequent weight loss. The accuracy of coil

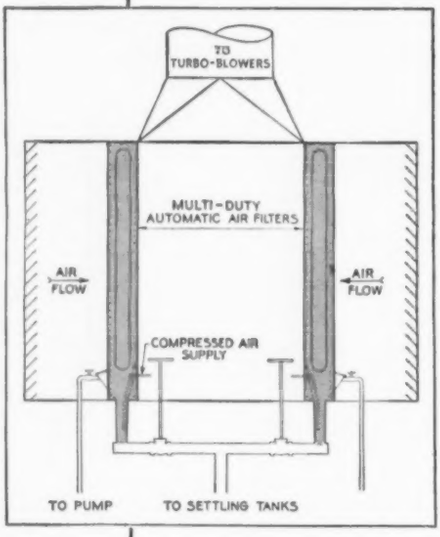
Filter the air

and you can

forget impeller blade erosion

YOU'VE got a maintenance problem in the making when you feed a turbo-blower raw air. The seemingly harmless particles of dust and dirt it contains become killers when they enter a high speed, rotary blower—and rapid wear and erosion of the impeller is the costly end result.

Scores of mills have solved this problem economically with the installation of AAF Multi-Duty Air Filters at the blower intake. Diagram at left shows a typical installation in which provision has also been made for quickly changing and cleaning the filter's oil bath.



The AAF Multi-Duty is an automatic self-cleaning air filter. Overlapping panel construction of the filter curtain combines positive self-cleaning and high efficiency air cleaning as integral functions of the operating cycle. Uniformly constant air supply is assured as operating resistance remains fixed when once established for a given dust concentration.

Here's one more opportunity to eliminate a possible source of shutdowns and costly repairs. For complete information on Multi-Duty's record in turbo-blower service, call your local AAF representative or write direct to—

AMERICAN AIR FILTER COMPANY, INC.

302 Central Avenue, Louisville 8, Ky.

In Canada: Darling Bros., Ltd., Montreal, P. Q.

®AAF

AIR FILTERS

AND ELECTRONIC PRECIPITATORS

These tongs require no electricity for holding.

handling is predicated on the annealing covers providing only a few inches of space between the outside diameter of the coils and inside diameter of the cover.

Other Heppenstall tongs were designed for the transportation of various burdens within River Rouge buildings, and for the movement of coils and ingots in outside storage.

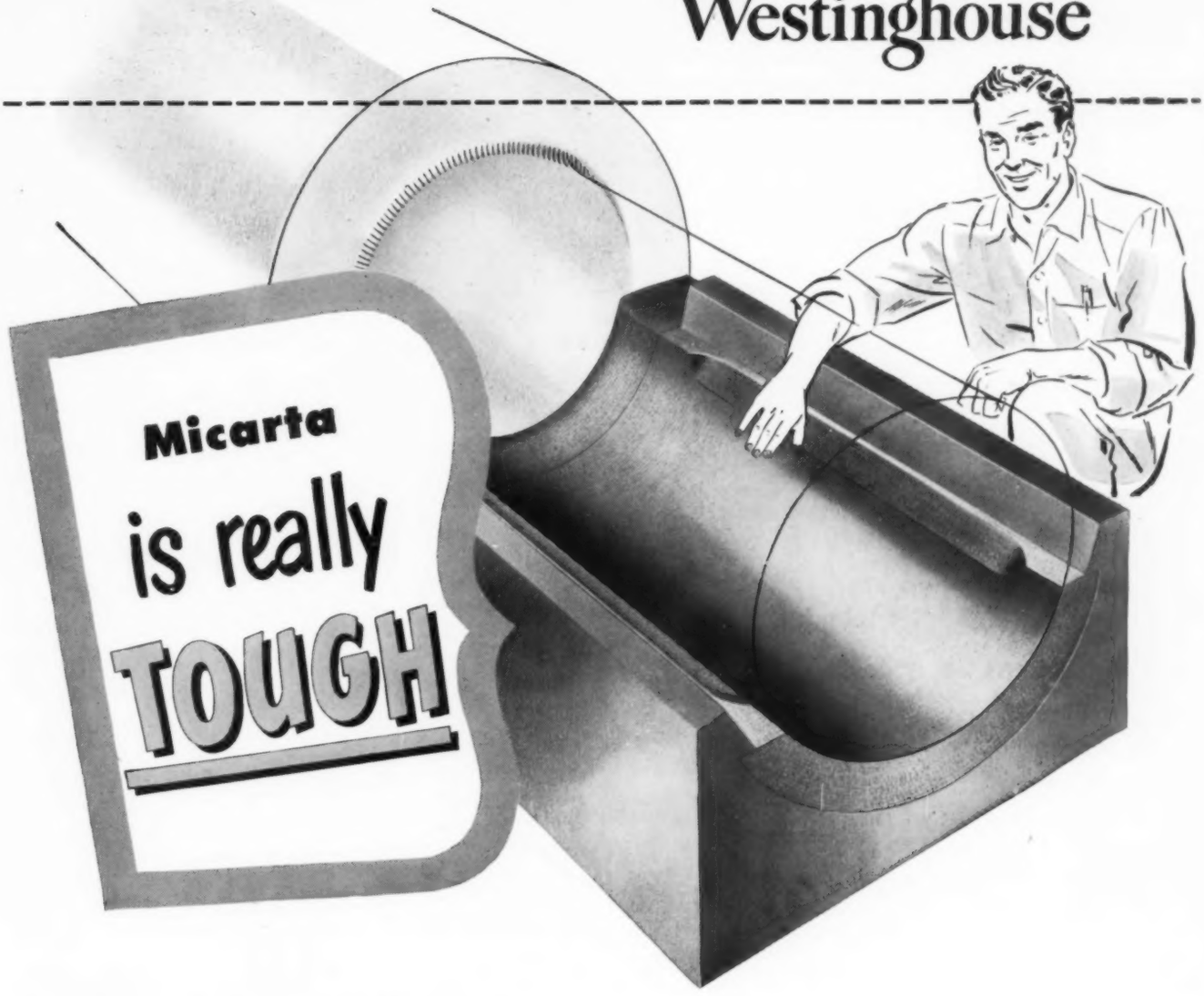
RAILROAD POWER JACKS HAVE STEEL MILL USE

▲ Duff-Norton Manufacturing Co. has announced the introduction of their improved air motor power jacks into the general industrial and construction fields. Long popular for lifting and lowering locomotives and freight cars, and for all other types of railroad maintenance, these powerful jacks are now employed in rigging and handling heavy industrial machinery, sinking piling, straightening steel pipe, pushing pipe and general plant maintenance.

Operated by an integral air motor under normal shop air pressure of 80 to 90 lb, the air motor power jacks not only save time and energy, but have unusual construction features which assure long and dependable service. The jacks are constructed of both steel and sturdy malleable iron which provide complete stability and withstand constant use under heavi-

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



. . . wears 10 to 15 times longer—

Micarta bearings last longer—10 to 15 times longer than lignum vitae—up to 80 times longer than metals.

That's because Micarta is really tough . . . because it's resilient, smooth and self-polishing—because it exceeds the compressive strength of steel, pound for pound.

This slow rate of wear means increased tonnage through fewer shutdowns for replacement . . . fewer screwdown adjustments and test bars. Costs are cut through savings in replacement expense, and prevention of damage to rolls and roll necks.

Micarta also improves steel-plate quality. Better holding of gauge results from its dense, hard, wear-resisting qualities. Closer tolerances on rolling fine-gauge materials are obtained.

Micarta can improve operation, cut costs in other ways, too. For data and application help, call your nearby Westinghouse office. Ask for Book B-3776, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-06423

Westinghouse Micarta

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These definite savings are yours if you use over 200,000 cubic feet of oxygen per month. With an Air Products Oxygen Generator you can:

- SAVE THE COST of transporting oxygen from a supplier's plant to your plant . . . generally a very large part of the cost of oxygen.
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With Air Products Generators on the job, low-cost oxygen is always in your plant when you need it. No capital investment for this equipment is required on your part. These same generators also produce high-quality nitrogen for inert atmosphere purposes.

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P. O. Box 538
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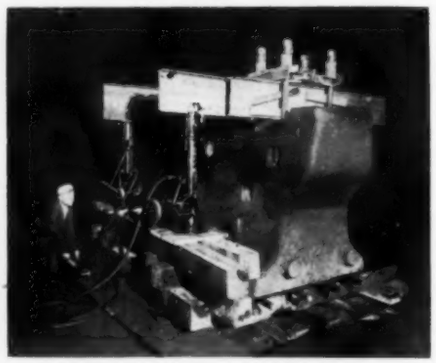
Air Products

OXYGEN GENERATORS

est loads. Long trundling handles and collapsible spotting handles make jacks easy to move and place, and solid rubber-tired roller bearing wheels facilitate easy long-range movements over rough surfaces or soft ground.

Actual raising and lowering are carefully controlled by the air motor, and an automatic shut-off prevents the ram from leaving the housing and spilling the load. Jacks are designed to prevent lowering or creeping in case of air failure due to disconnection or damage to the air hose. A safety key way in the ram checks the head from turning and shifting the load. Ball bearing thrusts and radial mountings further assure long service life and operation ease.



These jacks can be used in rigging and handling heavy machinery.

The jacks cut the time on most lifting jobs to only a fraction of that required by manually operated jacks. One man using two air power jacks can raise a railroad car in less than five minutes while the same job with manually operated jacks takes four men 38 minutes. A "Y" connection between jacks enables one man to operate two jacks simultaneously.

Jack maintenance is simple and quick and requires only a minimum of effort. Jacks are easily lubricated through conveniently situated plugs in the jack and air motor, and the screened-in air hose connection can be removed for cleaning. These Duff-Norton jacks have capacities from 20 to 100 tons, and are fully grease packed and tested for capacity loads before shipment.

ANTI-RUST PAINT USES ALUMINUM PASTE

▲ A new heavy duty aluminum anti-rust paint, known as "Rustrem Super Aluminum" is announced by Speco, Inc.

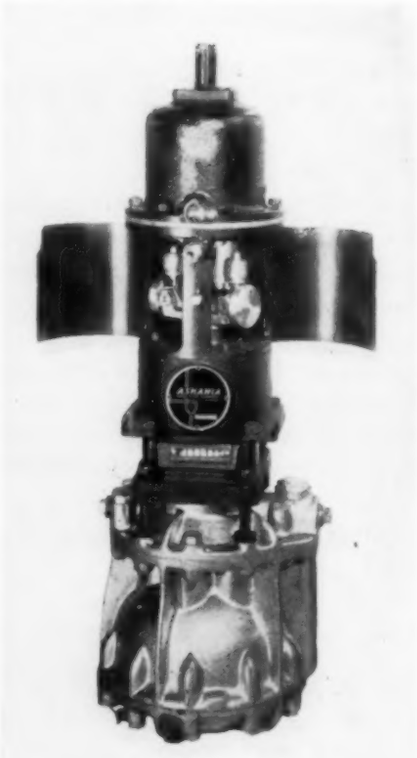
The new paint utilizes a recently developed aluminum paste which is reputed to be brighter and longer lasting than those ordinarily employed in paint manufacture. Its aluminum content is approximately double those of most aluminum paints, according to the manufacturer. It is guaranteed to "leaf" on all surfaces and will not turn brown under the most adverse weather conditions.

The aluminum paint can be applied right over rust without wire brushing or scraping. It penetrates and seals the surface, preventing further rust action. It is suitable for both interior and exterior use and is furnished in proper consistency for either brush or spray application.

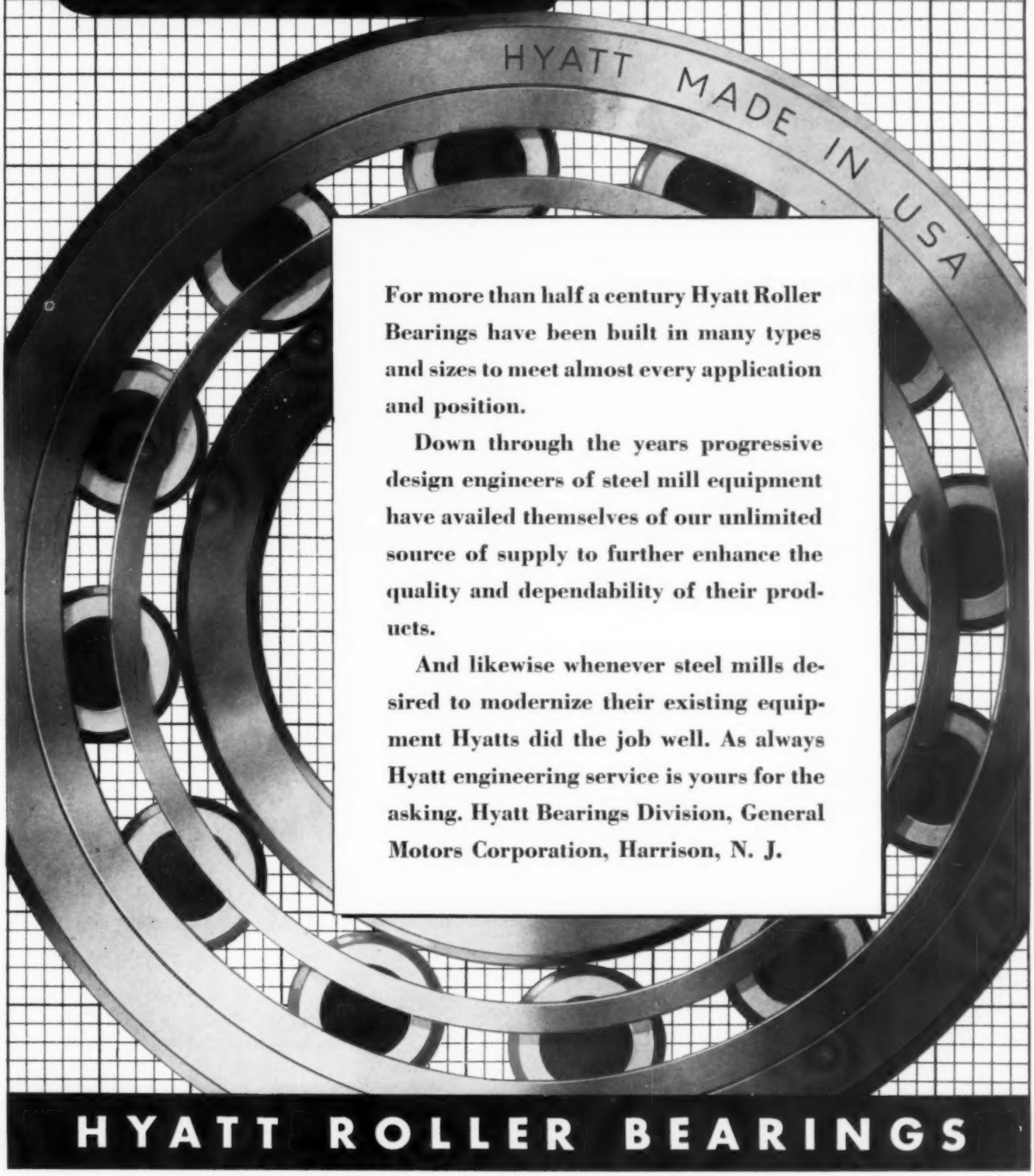
CONTROL GENERATES 2-15 LB AIR SIGNALS

▲ A new model of the "Transometer" which will generate an air pressure signal from 2–15 lb has been designed by the Askania Regulator Co. This new unit was designed in response to many requests for a "Transometer" that can be used directly with the present types of air operated controllers, eliminating the necessity for

The unit converts rpm of the positive displacement meter into an air pressure signal porportional to the square of the liquid flow.



There were no Roller Bearings before Hyatt made them



For more than half a century Hyatt Roller Bearings have been built in many types and sizes to meet almost every application and position.

Down through the years progressive design engineers of steel mill equipment have availed themselves of our unlimited source of supply to further enhance the quality and dependability of their products.

And likewise whenever steel mills desired to modernize their existing equipment Hyatts did the job well. As always Hyatt engineering service is yours for the asking. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

HYATT ROLLER BEARINGS

a transformer to convert the usual low pressure signals to the desired "2–15 psi" values. The new unit with its extended pressure range permits a broader application in the field of liquid flows.

The unit was developed originally as a means for translating liquid flows to low pressure air signals for measurement and control purposes. Combined with a positive displacement meter, it converts rpm of the positive displacement meter into an air pressure signal proportional to the square of the liquid flow. The second power signal can be matched directly with the second power signal, however, the second proportioning element must be biased to compensate for the initial 2 lb starting pressure.

Since it employs a positive displacement meter for measuring the liquid flows, viscosity effects on the measurements are small compared with the viscosity effects on measurements made by the usual orifice methods.

The Transometer can, however, be used for other speed control applications. The initial output pressure signal is adjustable over a range of 0 — 3 psi and the top output pressure signal over a range 10–18 psi. The maximum input rpm may vary from 25 to 3000 (or more).

Tests have shown that good results are possible down to 10 per cent of the maximum rpm for which the "Transometer" is designed.

TRUCKS USED FOR MANY OPERATIONS

▲ Industrial truck engineers are developing attachments whereby one truck is adaptable to many different kinds of load-handling operations.

Latest built by Elwell-Parker Electric Co. is notable for its simplicity and the ease with which it can be converted from fork to boom. Truck's driver can change from either one to the other in a few minutes without using special tools.

The attachment is particularly useful in metal working plants and others where loads are heavy and vary in shape and size. Also, in lighter industries generally using fork trucks but having need at times for moving goods or equipment best carried by means of rope or cable sling suspended from a boom. Both fork and boom can be used together for some jobs requiring extra security in handling.

The device has three main parts: A base member which is attached to the truck's lifting mechanism and which rides in the upright tilting columns; the fork tines suspended from a bar supported on the base; and the boom. The latter is a solid, alloy-steel heat-treated bar bent at right angles near the middle of its length. That part which engages the base is machined for a sliding fit into brackets and a base socket where it is held vertically and firmly in place.

When forks are to be used alone the boom is detached by slipping it out of its holder. When boom is required by itself the fork tines are swung upward and backward and held in this reversed position by means of pins in the brackets at top of the back-base. Tines clear truck mechanism at any working height.

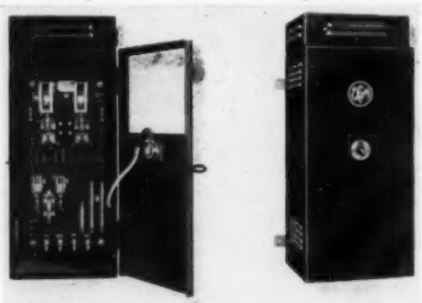
Boom in the model illustrated extends 36 in. horizontally from base. Fork tines are 36 in. long. Maximum height of lift of boom hook from floor is 30 to 145 in. Maximum height of fork is 117 in. Truck's rated capacity is 4000 lb.

CONTROLLER BUILT FOR LIFTING MAGNETS

▲ For use with large circular lifting magnets and heavy-duty rectangular magnets, Electric Controller & Manufacturing Co. has announced the new DLM-207-A magnet controller.

Of the automatic-discharge type, the discharge-feature is adjustable to suit size of magnet, material handled and voltage variations up to 10 per cent of normal voltage. The adjusting-dial, readily accessible on the exterior of the cabinet-door, permits the operator to control the opening of the reverse-current contactor for a quick, clean release of the load on the magnet.

A small, two-position (Lift-Drop) master switch, for mounting at the operator's station, controls application of power and de-energization of the magnet. The controller is automatically disconnected from the line after the master switch is moved to the drop position and the load is discharged. Fuses on controller panel protect the wiring between the controller and the master switch. The reverse-current contactor, closes against a factory-set spring and thus opens quickly and accurately.



TEMPERATURE INDICATOR FOR ECONOMICAL USE

▲ A new, economical, high temperature indicator for general, non-critical use has been announced by the Claud S. Gordon Co. This indicator is known as their "Model XA-100 Xactemp" indicator.

The manufacturer claims the meter to be accurate within a fraction of a scale division. Calibrated for either Iron-Constantan or Chromel-Alumel thermocouples, a choice of several scale ranges is available.

The indicator is accurate within a fraction of a scale division.

The indicator is furnished enclosed in a metal case suitable for either flush or surface mounting. A plug-in type of lead-wire connection provides easy handling.

SOME SHEAVES ELIMINATED FROM A-C LINE

▲ To make certain that only the best type of sheave is selected for each specific use, Allis-Chalmers is discontinuing its adjustable threaded plate sheaves in the larger sizes with the recommendation that "Vari-Pitch" sheaves be substituted.

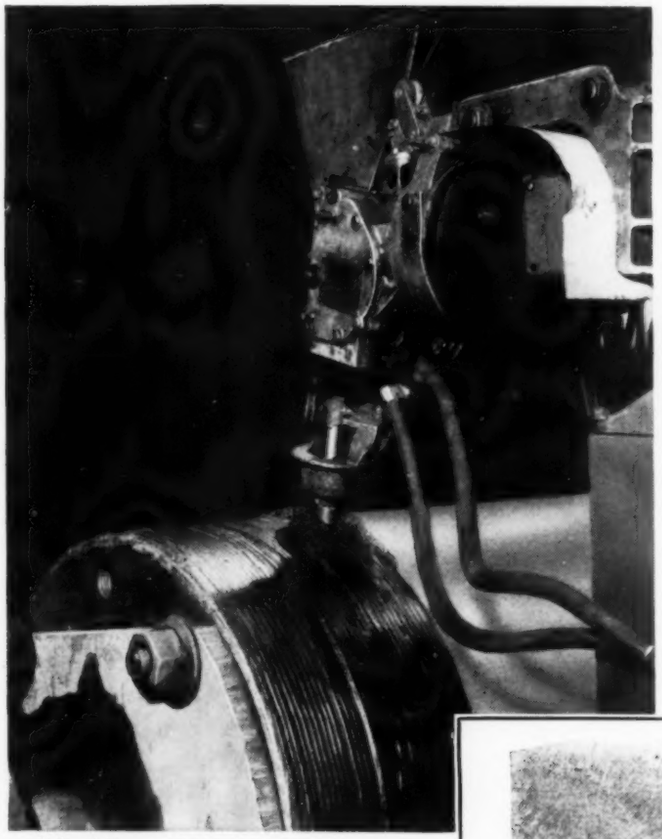
Reason for the new policy is that

Give New Life to Worn Parts

. . . *Rebuild Them by UNIONMELT Welding*

This automatic process saves time and money—welding is fast—parts are returned to service quickly—new surface is often superior to original—

Almost any part that can be suitably positioned can be rebuilt by UNIONMELT welding. It has been used successfully on parts such as steel mill rolls, guides, mandrels, journals; wheels for locomotives, cars, and cranes; pipe molds, and press plungers and cylinders.



Rebuilding a 24 in. diameter press plunger.

Deposits of almost any thickness can be made of—

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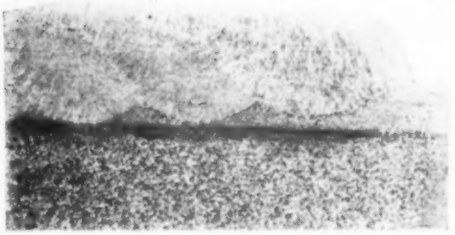
There are many LINDE methods of joining, rebuilding, forming, cutting and treating metals. LINDE Engineering Service can help you in production, construction, and maintenance. Just call the nearest LINDE office.



A flat surface is produced by offsetting each bead.

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users have tended to overload the larger size adjustable sheaves (6.300 up to 7.300 in. outside circumference) without properly anchoring the adjusting plates. Consequently, uniformly satisfactory service has not been possible.

Allis-Chalmers engineers recommend that when the horsepower of an adjustable speed drive exceeds 2 or 3, depending upon the application, a stationary control "Vari-Pitch" sheave be used instead. Adjustable sheaves up to and including 6.125 in. in outside circumference continue to be available.

CONTROL DOUBLES CHARGING CAPACITY

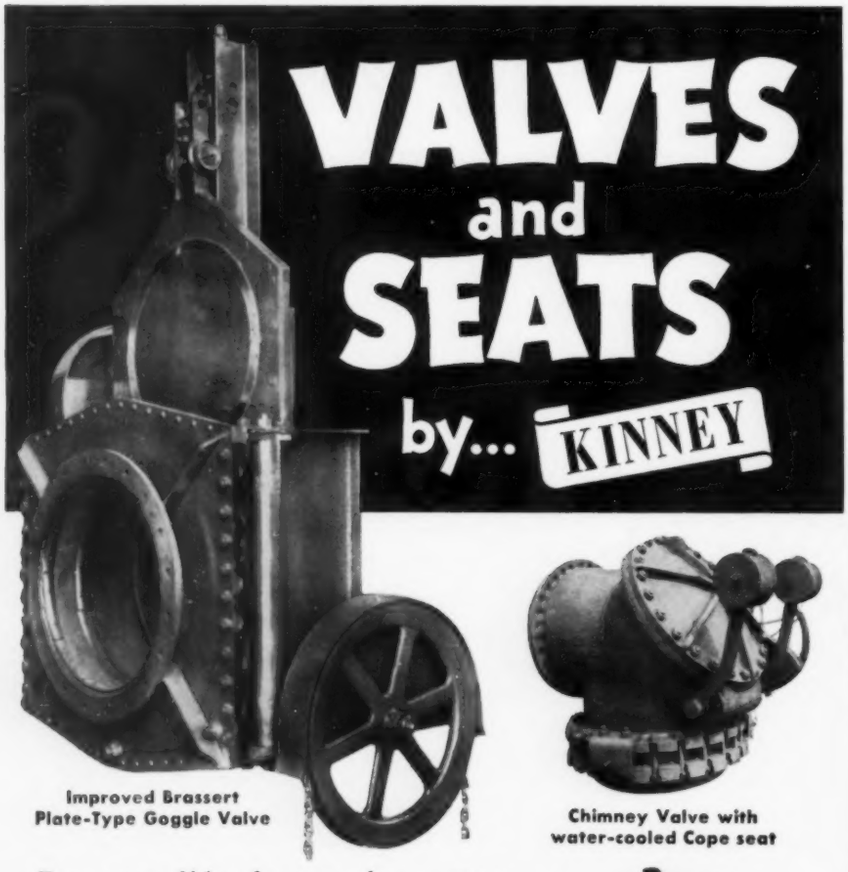
▲ The sequence charge control, a new device which can be attached to General Electric rectifier type truck battery chargers to double their working capacity, has been announced by the company's lighting and rectifier divisions.

The device makes it possible to charge two fully discharged batteries in 13 hours from a single rectifier. It utilizes the same automatic two-rate method of charging as employed in standard G-E rectifier chargers.

A high starting rate is applied first to one battery to bring it up to 80 to 90 per cent of full charge, then to the second battery. Both batteries then are automatically given the finishing charge simultaneously.

By the flick of a switch the basic characteristics of the original charger are restored so that a single battery can be charged in eight hours.

The sequence charge control can be attached to the battery charger unit by a competent electrician in about two hours.



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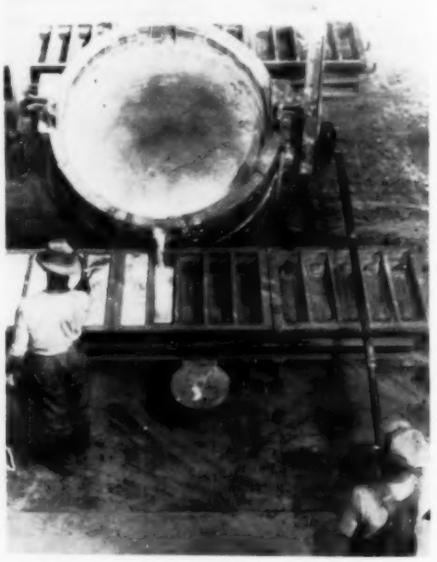
REYNOLDS METALS START CABLE PRODUCTION

▲ First "pigs" of virgin aluminum were poured April 15 from the newly opened pot line at the Reynolds Metals Co., Jones Mill, Ark., plant. Aluminum produced on this new pot line will go into the production of aluminum cable immediately. The first reel of this steel reinforced cable for use by REA cooperatives has already been delivered and will soon be carrying electricity to light the homes of rural America.



The addition of another cable manufacturer will ease the serious cable shortage.

Reynolds plans to open an additional pot line late this year at their Jones Mill plant when the Lake Catherine steam plant is completed and power is made available under provisions of a 30-year contract. This will permit a peak annual capacity of 144,000,000 lb of aluminum from this one plant.

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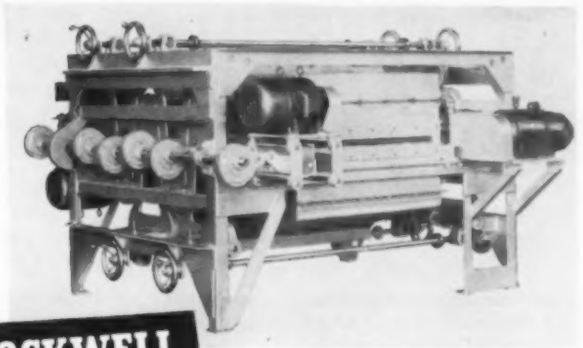

ROCKWELL BRUSHING MACHINE

Provides a continuous, speedy cleaning of steel or non-ferrous strip, for removing thin scale, loose zinc oxide, carbon and foreign matter. The strip, in single broad width or multiple narrow widths, bears against the back-up roll, motor driven at same speed as the moving strip. Adjustable brushes rotate in direction opposite to strip travel and oscillate so as to prevent strip from wearing each brush. Wringer rolls at both ends of the tank wring off acid and clean water.

During brushing, strip is constantly sprayed and loose material is drained off. (The set-up can be arranged for dry brushing.) A hot water rinse is also provided. Designed to your strip cleaning requirements.

Rockwell also builds batch and continuous furnaces, coil boxes, coilers, strip stitchers, pickling tanks and machines, dryers, ovens and special equipment.

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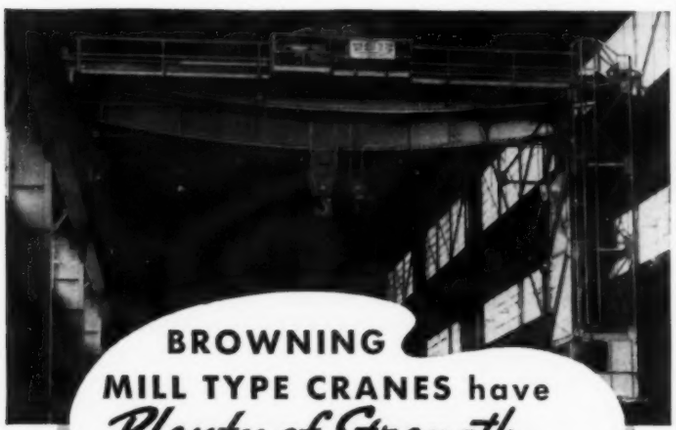

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UNIT HEATER FEATURES SQUIRREL CAGE FAN

▲ A blower type unit heater which features a squirrel cage fan has recently been added to the line of Pittsburgh gas unit heaters by Automatic Gas Equipment Co.

Known as the Pittsburgh blower unit, Series "CB", the new heater is designed for installations which require heated air at greater velocities and against greater static pressure than provided by standard unit heaters equipped with the conventional propeller type fans. The unit is supplied in five sizes, with AGA output as follows: 172,000; 136,000; 112,000; 84,000, and 68,000 Btu per hour.

The heater is designed for installations which require heated air at greater velocities.

The blower unit is the same basic unit as standard Pittsburgh gas unit heaters and, as in the latter case, is equipped with cast iron heat exchanger and combustion chamber to withstand the corrosive effects of burning gases. The combustion chamber and heat exchanger are cast in one piece, and the extended heating surface fins on the heat exchanger are cast integral. A built-in draft hood absorbs all excessive chimney action and thereby conserves heat.

NEW BATTERY CHARGER IS FULLY AUTOMATIC

▲ Electric Products Co., announces the complete redesigning of their "Type S" single-circuit battery charger for servicing the batteries of motive-power industrial electric trucks.

Simplicity and reliability are two of the outstanding features of the charger. To operate, just connect the battery to the charger, snap the toggle switch to "on" and push the white button on the charge-control unit for lead batteries or set ampere-hour meter for Edison batteries.

No manual attention is required during the charge. Only this type of charging equipment has really full-automatic operation which past experience has proved to be necessary for safe and economical charging of industrial-truck batteries.

Compact and self-contained, the charger minimizes installation time and expense. To put in operation, just connect to the a-c power supply through a suitable disconnect switch. Note that the control panel is an integral part of the charger. Even the motor starter is pre-mounted within the cabinet.

When you request more information say you read it in the **IRON AND STEEL ENGINEER**

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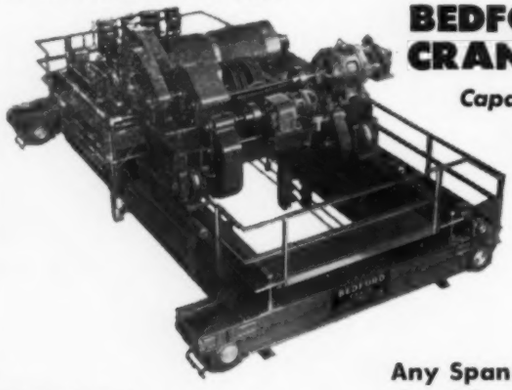

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Book Reviews

▲ "Standards for Mining Belt Conveyors, Publication No. 49-142" has recently been published by NEMA. This publication covers sectional-type electrically driven belt conveyors such as are commonly used underground in coal mines, metal mines, non-metallic mines, tunnels and above the ground in open-pit mines, wherever the conveyor is lengthened or shortened as mining operations advance or retreat. Such conveyors are designed to carry belts up to and including 48 in. in width. 20 pages, $0.50.

"Standards for Rubber Insulated Power and Control Cables, Publication No. 49-141" just issued apply to rubber insulated single and multiple-conductor power and control cables which are used for the transmission and distribution of electrical energy under normal conditions of installation and service, either underground, submarine, aerial or indoor.

The construction of cables, test requirements for cables and component materials and the dimensional measurement of component parts of completed cable are covered. Also included are seven appendices of importance to all users of power and control cables. 68 pages, $3.00.

▲ "Design for Welding," published by The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio; over 1000 pages, 5½ x 7½ in., profusely illustrated with photographs, drawings, tables and cost data; bound in semi-flexible simulated leather covers; price $2.00, postage prepaid in the United States; $2.50 elsewhere. This book is a significant record of the progress of arc welding throughout all industry during the post-war years.

The book is composed of abstracts of 82 award papers in the recent Foundation "Design - for - Progress" Award Program. The papers were selected and edited by Professor R. S. Green, acting chairman of the department of welding engineering of the Ohio State University, Columbus, Ohio.

▲ "Treatise on Powder Metallurgy" —Volume I, technology of metal powders and their products by Claus G. Goetzel, Ph.D., vice president and director of research, Sintercast Corp. of America, N. Y. Published by Interscience Publishers, Inc., New York, N. Y. Cloth 6 x 9, 806 pages, 300 illustrations, 82 tables, $15.

▲ Gray Iron Founders' Society has just published a revised "Basic Cost Manual" for Gray Iron Foundries. The manual is unique in its presentation of foundry cost fundamentals which are displayed in simple, graphic form. There are sections of the book devoted to a general description of basic cost finding principles, how to install and operate the system and a special section of interest to managers, executives, sales managers, etc.

The manual contains 51 printed pages, size 8½ x 11, and is attractively printed and bound; price five dollars ($5.00) per copy. Orders should be addressed to Gray Iron Founders' Society, Inc., 210 National City-East Sixth Building, Cleveland 14, Ohio.

▲ The eleventh edition of the Standard Metal Directory has just been published, the previous one having been published in 1946. The new volume contains 999 pages, an increase of 146 pages over the previous edition. It is bound in cloth, 6 x 9¼ in., and has been completely revised and brought up to date. The directory is divided into five sections, embracing iron and steel plants; ferrous and non-ferrous metal foundries; metal rolling mills; smelters and refiners of non-ferrous metals, and a new section called: "Metal Products Index" which lists geographically distributors of steel and metal products, arranged to commodities.

The directory contains more than 10,000 detailed reports on steel mills, foundries, smelters, rolling mills and non-ferrous metal plants, located in the United States and Canada, giving the name of the company, its capitalization, location of plants, company's officers, purchasing agent, sales manager, plant equipment, products manufactured and type of primary and secondary raw materials consumed.

The Standard Metal Directory is published by the Atlas Publishing Co., 425 West 25th St., New York 1, N. Y., and sells for $15.00 a copy.

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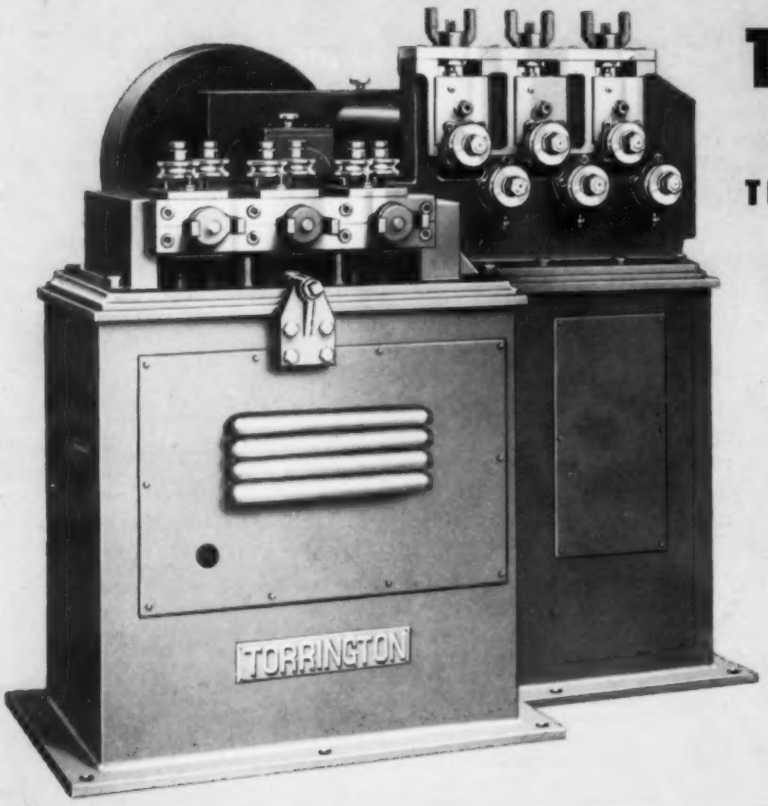

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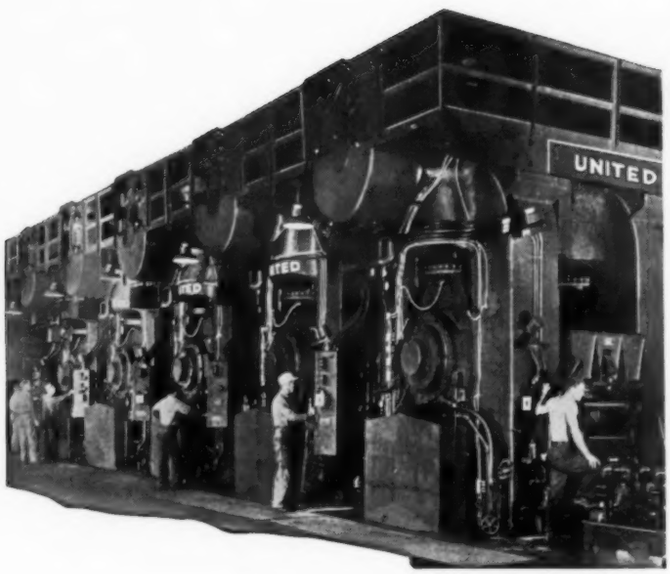

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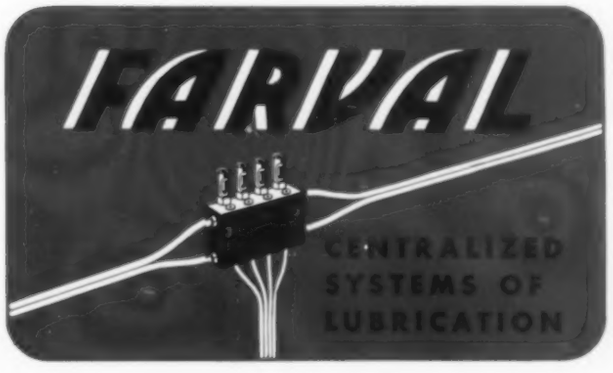
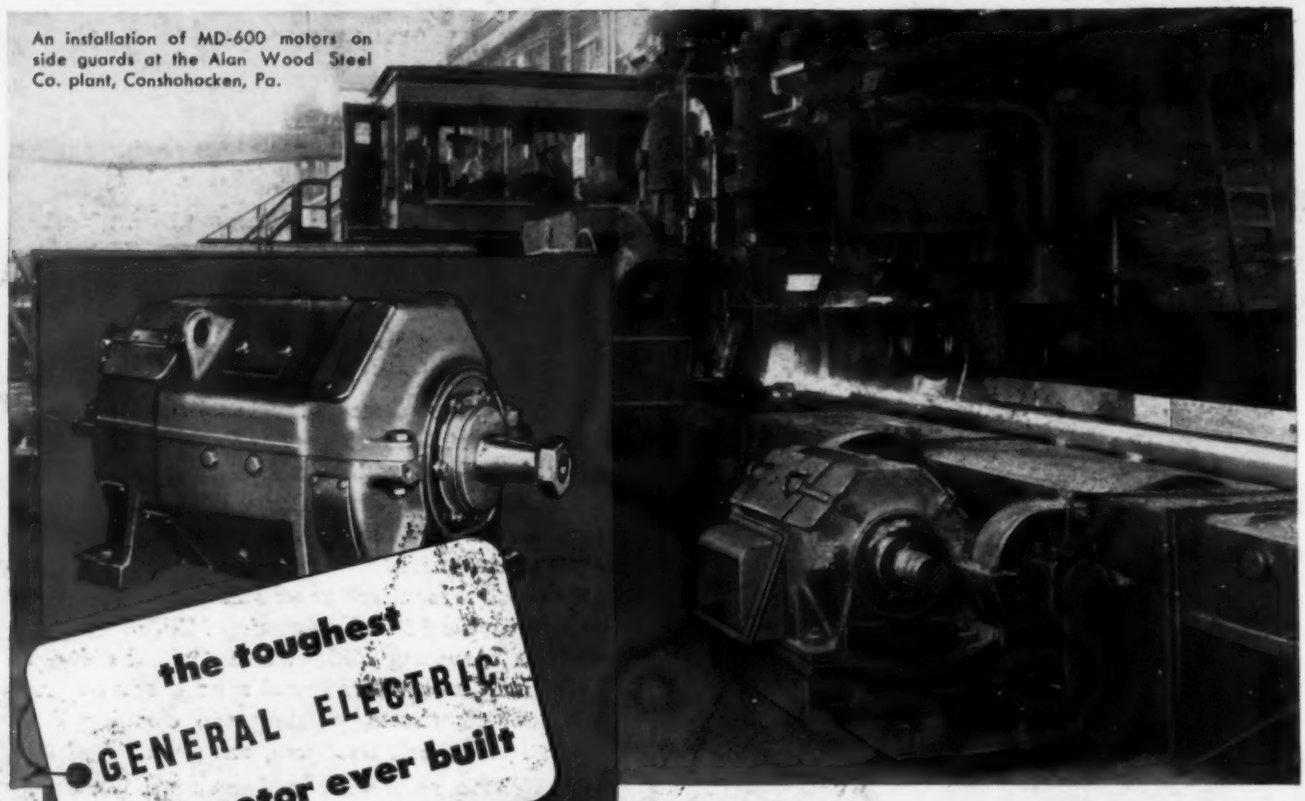
FARVAL—*Studies in Centralized Lubrication No. 109*





An installation of MD-600 motors on side guards at the Alan Wood Steel Co. plant, Conshohocken, Pa.

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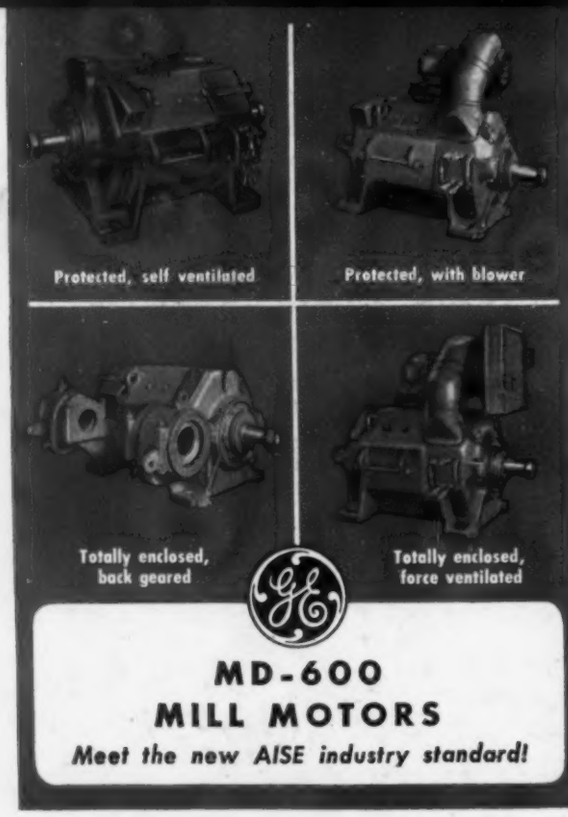

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